GULF COAST GEOPRESSURED - GEOTHERMAL PROGRAM SUMMARY REPORT COMPILATION

DOE/ID/13366--T1-Vol.4

VOLUME IV

BIBLIOGRAPHY (ANNOTATED ONLY FOR ALL MAJOR REPORTS)

WORK PERFORMED UNDER U.S. DEPARTMENT OF ENERGY
CONTRACT NO. DE-FG07-95ID13366

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JUNE, 1998

DISCLAIMER

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NOTE

This bibliography contains United States Department of Energy sponsored Geopressured-Geothermal reports published after 1984. Reports published prior to 1984 are documented in the Geopressured Geothermal bibliography Volumes I, II, and III that the Center for Energy Studies at the University of Texas at Austin compiled in May 1985 which was jointly sponsored by U.S. Department of Energy and Gas Research Institute under contract # DE-AC-08-79-ET-27112 and 5084-212-0924.

TITLE: ***Geopressured Geothermal Bibliography Volumes I, II, and III***

AUTHORS: Sepehrnoori, Kamy, Antonia Colias, Robert Schneider, Shobhan Parthasarathy, Frances Carter, Steve Street, and Kira McGill
PUBLISHER: Geopressured Geothermal Information System Center for Energy Studies The University of Texas at Austin
PAGINATION: Volume I and II--1180 Volume III--203
PUBLICATION DATE: May 1985
SPONSOR: DOE and Gas Research Institute
REPORT OR CONTRACT#: DE AC 08 79 ET 27112 and 5084-212-0924
DESCRIPTORS: N/A

SCOPE: The Center for Energy Studies at the University of Texas at Austin has compiled the Geopressured Geothermal Bibliography for researchers in the field of geopressured geothermal energy resources. It represents reports, papers and articles covering topics from the scientific and technical aspects of geopressured geothermal reservoirs to the social, environmental, and legal considerations of exploiting those reservoirs for their energy resources.

TITLE: ***A Comparison of Estimated Subsidence Rates Associated With Geopressured Geothermal Development To Background Subsidence Rates Texas-Louisiana***

AUTHORS: Harding, R .C., L.M. Lee, J. Everingham, M. Clayton, and A. Massa
PUBLISHER: EWDAW-ESA
PAGINATION: 136
PUBLICATION DATE: May 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC03-76SF00098
DESCRIPTORS: Texas-Louisiana Gulf Coast, Static, Subsidence, Background subsidence, and Gulf Coast Geosyncline

SCOPE:

This report establishes the Texas-Louisiana Gulf Coast rates of subsidence caused by on-going natural and man-induced processes. A comparison of these background rates of subsidence with estimated subsidence rates associated with potential geopressured geothermal resource development is illustrated. This report also evaluates the significance of potential geopressured geothermal-related subsidence rates in light of ongoing background subsidence rates.

TITLE: ***A Compilation of Data on Fluids From Geothermal Resources in the U.S.***

AUTHORS: Cosner, S.R. and J. A. Apps
PUBLISHER: Earth Sciences Division Lawrence Berkeley Laboratory, University of California
PAGINATION: 108
PUBLICATION DATE: May 1978
SPONSOR: DOE
REPORT OR CONTRACT#: W-7405-ENG-48
DESCRIPTORS: Liquid dominated resources, Vapor dominated resources, Well data, Sampling information, Physical data, Brine data, and Bibliographic data

SCOPE:

This report provides information on the chemistry of geothermal fluids to scientists and engineers involved with the development of liquid dominated geothermal energy resources. This compilation is a comprehensive tabulation of available geothermal fluid data from the most important geothermal resources in the United States. For each resource listed in this report, a description of preliminary information, well data, sampling information, physical data, brine data, and bibliographic data are included.

TITLE: ***A Plan For the Long Term Environmental Assessment of Geopressure Resource Development in the Louisiana Gulf Coast Region***

AUTHORS: Newchurch, E.J., C.F. Bryan, D.P. Harrison, R.A. Muller, R.E. Wilcox, A.L. Bachman, P.J. Newman, K.J. Cummingham, R.K. Hilding, and J.A. Rehage
PUBLISHER: Institute for Environmental Studies Louisiana State University
PAGINATION: 331
PUBLICATION DATE: July 1978
SPONSOR: DOE- The Assistant Secretary for the Environment
REPORT OR CONTRACT #: not given
DESCRIPTORS: Geological effects, Air quality, Water quality, Ecosystem quality, and Socioeconomic and cultural considerations

SCOPE:

This report presents the results of research, by the Institute for Environmental Studies, to develop a plan for the long-term environmental assessment of geopressured/geothermal resource development in the Louisiana Gulf Coast region. This work was sponsored by the Lawrence Livermore Laboratory under Purchase Order No. 8316603, as part of its Contract No. W-7405 -Eng. 48 with the U.S. Department of Energy (DOE).

Lawrence Livermore Laboratory has authorized the study described in this report to identify key environmental issues, to assess the adequacy of presently available environmental data, and to prepare a plan for: (1) acquiring additional baseline data; and (2) monitoring the environmental effects of geopressured resource development. This plan is designed to provide information necessary for informed decision making concerning the long-term environmental assessment of geopressured resource development in Louisiana.

TITLE: ***A Preliminary Environmental Assessment of Selected Geopressured-Geothermal Prospect Areas: Louisiana Gulf Coast Region***
SUBTITLE: ***Volume I Comparison of Prospect Areas on the Basis of Potential Environmental Impacts and Volume II Environmental Baseline Data***

AUTHORS: Newchurch, E.J., A.L. Bachman, C.F. Bryan, D.P. Harrison, R.A. Muller Jr., J.P. Newman, Jr., C.G. Smith, Jr., J.I. Bailey, Jr., G.G. Kelly, and K.C. Reibert
PUBLISHER: Institute for Environmental Studies, Louisiana State University

PAGINATION: Volume I: 140 and Volume II: 262
PUBLICATION DATE: October 1978
SPONSOR: DOE
REPORT OR CONTRACT#: ET-78-S-05-5862
DESCRIPTORS: Land use, Geologic effects, Air quality and noise, Water quality, Ecosystem effects, and Natural hazards

SCOPE:

This two-volume report presents the results of a preliminary environmental assessment of the following geopressured-geothermal prospect areas in the Louisiana Gulf coast region: South Johnson's Bayou, Sweet Lake, Rockefeller Refuge, Southeast Pecan Island, Atchafalaya Bay, and Lafourche Crossing.

In Volume I, the prospect areas are compared to determine their relative environmental acceptability for the test program. Trade-offs among the prospects in terms of potential impacts are highlighted. This assessment was made on the basis of the nature and extent of the proposed testing activities in view of the environmental characteristics of each prospect area: land use, geology and geohydrology, air quality, water resources and quality, ecological systems, and natural hazards. Volume II includes a compilation of environmental baseline data for each prospect area derived from existing sources.

TITLE: ***A Prospectus***
SUBTITLE: ***Geopressured Geothermal Prospects and Test-Well Sites Wilcox Group and Frio Formation Texas Gulf Coast***

AUTHORS: Bebout, D. G., A.R. Gregory, R.G. Loucks, and B.R. Weise
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 27; 5 electric logs
PUBLICATION DATE: December 1978
SPONSOR: DOE
REPORT OR CONTRACT#:not given
DESCRIPTORS: Geothermal gradients, Salinity and temperatures of formation waters, Shale resistivity, and Methane solubility

SCOPE:

The four geopressured geothermal prospects and test-well sites described in this report are believed to represent the most favorable locations for testing the resource along the Texas Gulf

Coast. Detailed stratigraphic and structural cross sections and net-sandstone and structure maps have been prepared for the fairways in which these prospects are located. These prospects and sites have been chosen on the basis of geology alone and that equally important environmental and legal (surface and mineral rights) aspects have not been considered.

TITLE: ***A Reconnaissance Noise Survey Near the Parcperdue Geopressure Well Test Site***

AUTHOR: not given
PUBLISHER: Teledyne Geotech
PAGINATION: 13
PUBLICATION DATE: not given
SPONSOR: DOE and Louisiana State University
REPORT OR CONTRACT: not given
DESCRIPTORS: Data acquisition, Data analysis, Noise survey, Spectral estimates, and Amplitude response

SCOPE:

Dow Chemical USA, under contract with the U. S. Department of Energy, sponsored a project to drill and test a geopressured well in the vicinity of Parcperdue, Louisiana. Louisiana State University under contract with the U. S. Department of Energy and in cooperation with Dow Chemical USA, planned an associated environmental monitoring program. The goals outlined by the test plan include a geologic and environmental assessment of the effects of the production and disposing of geopressured fluids.

Teledyne Geotech has been authorized by the University to conduct a micro-seismic monitoring program in the Parcperdue area prior to and during the well production. Microseismic data acquired before production will serve to establish a baseline representative of the natural seismic activity within the area. Therefore, at any time during the progression of the production test, a change in the microseismic activity level can be detected by comparison of the current data to the established baseline.

The monitoring network will consist of five remotely operated seismic sensors that will continuously record data. The sensors (Geotech Model S-13) will be installed in sealed containers at a depth of approximately four feet.

The first task associated with the Parcperdue monitoring program is the performance of a reconnaissance noise survey to identify seismically quiet locations for the installation of sensor sites. This task has been completed, and the results of the seismic noise survey are presented in this report.

TITLE: ***A Study of Hydrocarbons Associated with Brines from DOE Geopressured Wells***
SUBTITLE: ***Cooperative Agreement :DE-FC07-9ID12945 FINAL REPORT***

AUTHORS: Keeley, Dean F.
PUBLISHER: Acadiana Research Laboratory University of Southwestern Louisiana
PAGINATION: 69
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Distribution coefficients and solubilities, Brines, Aliphatic Hydrocarbons, Geopressured reservoir hydrocarbons, and Gas scrubber

SCOPE:

This report contains a detailed description of task preformed on the hydrocarbons associated with brines. The tasks that were administered are listed below.

Distribution Coefficients and Solubilities
DOE Design Well Sampling
Analysis of Well Samples
Review of Theoretical Models of Geopressured Reservoir Hydrocarbons
Monitor for Aliphatic Hydrocarbons
Development of a pH Meter Probe
Perform DOE Design Well Scrubber Analysis
Removal and Disposition of Gas Scrubber Equipment at Pleasant Bayou Well
Disposition of Archived Brines

TITLE: ***A Survey of Potential Geopressured Resource Areas in California: Final Report***

AUTHOR: not given
PUBLISHER: GeothermEx, Inc.
PAGINATION: 188
PUBLICATION DATE: March 1993
SPONSOR: California Energy Commission
REPORT OR CONTRACT: not given
DESCRIPTORS: Geopressure zones and Geopressure pools

SCOPE:

This study began with a literature search and a systematic screening procedure to identify geopressured resources in California using published data collected from more than 150,000 oil and gas wells which have been drilled in the California. Geopressured pools are identified and the relationship between geopressure and temperature are examined. Specific methodologies are established to identify the geopressured interval from drilling and logging data. Methods of quantifying the amount of geopressure from well logs in each pool are discussed along with several other parameters of interest to further characterize the geopressure resource base in California.

TITLE: ***A Survey for the Industrial Application of Non-Electric Geopressured Geothermal Resources To Food and Feed Product Processing***

AUTHOR: Technological Resources, Inc.
PUBLISHER: De Laureal Engineers, Inc.
PAGINATION: 39
PUBLICATION DATE: 1978
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: Product processing and Energy requirements

SCOPE:

A study of Food and Feed Products processed in Southern Louisiana was conducted. Based upon selected products, five specific processes were reviewed and described, then energy requirements were calculated to determine the requirements to process each product per 1000 pounds of finished materials.

TITLE: ***An Economic and Financial Evaluation of Geopressured-Geothermal Resource Development***
SUBTITLE: ***Geopressured-Geothermal Technical Paper No. 2***

AUTHOR: RPC, Inc.
PUBLISHER: U.S. Department of Energy Geothermal Energy
PAGINATION: 98
PUBLICATION DATE: July 1979

SPONSOR: DOE
REPORT OR CONTRACT#: ET-78-G-05-5958
DESCRIPTIONS: Analytical framework, Model simulations, and Leasing policies

SCOPE:

The purpose of the financial analysis was to provide the School Land Board and General Land Office of Texas with an analytical framework for analyzing the effect of leasing policies on the financial feasibility of geopressured-geothermal field development. Such an analytical framework was developed and was applied to eleven sets of development assumptions. The analytical framework, its applications, and results are discussed in this report.

TITLE: ***An Environmental Overview of Geopressured-Geothermal Development: Texas Gulf Coast***

AUTHORS: Gustavson, Thomas C. and Charles Kreitler
PUBLICATION: Bureau of Economic Geology University of Texas
PAGINATION: 184
PUBLICATION DATE: 1979
SPONSOR: Environmental Sciences Division Lawrence Livermore Laboratory and Assistant Secretary for the Environment --DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Recommended environmental programs and Socioeconomic and cultural considerations

SCOPE:

Environmental studies dealing with the development of geopressured-geothermal resources in the Texas Coastal Zone indicate that the major impacts on the ecosystem are likely to result from surface disposal or accidental release of geothermal fluids, from surface subsidence induced by fluid withdrawal, and from habitat loss resulting from the construction of the power plant and well field. In view of this, site specific and general environmental studies are recommended in this report.

TITLE: ***Analysis of Diagnostic Testing of Gladys McCall Well No.1***
SUBTITLE: ***Preliminary Topical Report***

AUTHORS: Riney, T.D. and S.K. Garg

PUBLISHER: S-Cubed
PAGINATION: 30
PUBLICATION DATE: December 1991
SPONSOR: DOE
REPORT OR CONTRACT #: DEFC07-85NV10412
DESCRIPTORS: Geothermal energy, Geopressured resource, and Reservoir engineering

SCOPE:

Gladys McCall Well No. 1 was flow tested from 1983 to 1987, underwent long-term pressure buildup testing from October 1987 to October 1991, and re-entered for final diagnostic testing. The combination of a very large, poorly defined reservoir with data from only a single well has required that the testing be carried out over an unusually long time period for an understanding of the pressure maintenance mechanisms to be developed.

Ongoing diagnostic testing of the well has been undertaken by DOE to help resolve questions that arose during the analysis of the test data from the eight year depletion and recovery testing. The final pressure buildup data in the comparison with the earlier reservoir simulation model is included in this report.

TITLE: ***Analysis of Flow Data from the DOW/DOE L.R. Sweezy No. 1 Well***
SUBTITLE: ***Topical Report***

AUTHORS: Garg, S.K. and T.D. Riney
PUBLISHER: S-CUBED
PAGINATION: 89
PUBLICATION DATE: February 1984
REPORT OR CONTRACT#: DE-AC08-80-NV10150
SPONSOR: DOE- Nevada Operations Office
DESCRIPTORS: Multiple-Rate analysis, Drawdown analysis, Buildup analysis, Reservoir depletion analysis behavior, Otis Engineering Reservoir Model, and Parametric studies

AUTHOR'S ABSTRACT:

This topical report presents the results of S-CUBED's work to-date on the analysis and

simulation of flow and pressure data from the testing of the L.R. Sweezy No. 1 well. Analysis of drawdown data indicates a formation permeability of around 126 md, and a flow-rate dependent skin. The conventional analysis techniques were, however, found to be inadequate for analyzing the buildup data. The formation properties inferred from the drawdown were used together with the CHARGR simulator to simulate the production history of the Sweezy well. The calculated drawdown response displays excellent agreement with the measured data; such agreement was, however, not obtained for the buildup phase of the tests. Parametric calculations designed to investigate the anomalous buildup response suggest that this behavior may be the result of stress-induced hysteresis in formation properties, shale recharge, long-term formation creep. A research program to further characterize the observed pressure response is outlined.

TITLE: ***Analysis of Flow Data From the T-F&S/DOE Gladys McCall No. 1 Well***
SUBTITLE: ***Final Report***

AUTHORS: Prichett, J.W. and T.D Riney
PUBLISHER: S-Cubed
PAGINATION: 89
PUBLICATION DATE: January 1985
REPORT OR CONTRACT#: DE-AC08-80-NV10150
SPONSOR: DOE- Nevada Operations Office
DESCRIPTORS: Sand No. 8 and No. 9, Reservoir limits test, and Production history

AUTHOR'S ABSTRACT:

The flow and bottomhole pressure data have been analyzed for the two sands (Nos. 8 and 9) tested by the Gladys McCall No. 1 Well. The more productive sand (No. 8) appears to be bounded by two linear faults at distances of ~ 740 feet and ~ 1360 feet from the well and there appears to be a decrease in the formation transmissivity away from the well. The formation properties inferred from the well test analysis have been used with a reservoir simulator to match the bottomhole drawdown/buildup history measured during the Reservoir Limits Test of Sand Zone No. 8. Wellhead pressure data measured during the long-term production testing of Sand Zone No. 8 have been employed to estimate the corresponding downhole pressures. The simulation model based solely on the Reservoir Limits Test is found to be in remarkably good agreement with the estimated bottomhole pressures for the first six months of production testing, but enlargement of the reservoir volume, by moving the boundary most remote from the well outward, is required to adequately match the full production history. The added remote volume corresponds to an increase by a factor of three in the estimated reservoir volume. The results for the Gladys McCall well are discussed in the context of earlier results determined from testing the other through geopressured geothermal design wells (Pleasant Bayou No. 2, Amoco Fee No. 1 and L. R. Sweezy No. 1 Well) and a

parametric calculations performed by S-CUBED to define the brine and gas recovery from geopressured systems (Garg and Riney, 1984b).

TITLE: ***Analysis of Preliminary Testing of Willis Hulin Well No. 1***
SUBTITLE: ***Technical Report***

AUTHORS: Riney, T.D.
PUBLISHER: S-Cubed
PAGINATION: 54
PUBLICATION DATE: September 1991
REPORT OR CONTRACT#: DE-AC03-76SF00098
SPONSOR: DOE (Subcontracted by Lawrence Berkely Laboratory)
DESCRIPTORS: Preliminary flow testing, Fluid and formation properties, Proximal connected pore volume estimate, Pressure transient data analysis, Wellbore calculations, and Reservoir simulation calculations

SCOPE:

The U. S. Department of Energy (DOE) has both drilled and tested four deep research wells in the Texas-Louisiana Gulf Coast region as part of its program to define the magnitude and recoverability of the geopressured-geothermal energy resource. DOE also took over nine wells from industry (before being abandoned) and tested them for short periods to determine fluid properties. The Willis Hulin Well No. 1, located about 7.5 miles south of the town of Erath, Louisiana, is the first well taken over from industry for possible long-term testing. This well penetrates the deepest known Gulf Coast geopressured-geothermal reservoir.

TITLE: ***Annotated Bibliography of Studies on the Density and other Volumetric Properties for Major Components in Geothermal Waters 1928-1974***
SUBTITLE: ***Geological Survey Bulletin 1471***

AUTHORS: Potter, W.R. II, D.R. Shaw, and J.L. Haas, Jr.
PUBLISHER: U.S. Geological Survey Department of the Interior
PAGINATION: 78
PUBLICATION DATE: 1975

SPONSOR: U.S. Geological Survey Department of the Interior
REPORT OR CONTRACT#: N\A
DESCRIPTORS: N/A

SCOPE:

This bibliography supplies an annotated list of references pertaining to the density of solutions of importance in geothermal exploration and energy production.

TITLE: ***Annual Report on the Seismic Monitoring Network in the Vicinity of the Rockefeller Refuge, Louisiana Gladys McCall Geopressured Well Site Covering the Period 1 April, 1981- 31 March, 1982***

AUTHOR: Statton, Thomas (Project Coordinator) and James D. Agnew (Senior Staff Seismologist)
PUBLISHER: Woodward-Clyde Consultants
PAGINATION: 34
PUBLICATION DATE: July 1982
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Velocity model, Magnitude, Background noise, Data character, and Natural seismicity

SCOPE:

As part of the search for alternate energy sources, the Department of Energy is funding the design, drilling and testing of a geopressure/geothermal energy well near Grand Chenier, Louisiana (D. O. E./Gladys McCall No. 1). Production of economic quantities of methane and heat energy are dependent on high volume withdrawal and reinjection of brine (up to 30,000 bbl/day). Sustained high-level pumping of this type may have a measurable effect on the surrounding area. As part of an environmental-monitoring program for the test well, Woodward -Clyde Consultants, with the supervision of Louisiana State University and the Louisiana Geological Survey, has installed a seismic monitoring network consisting of eight seismometer stations placed at various distances from the well site. The purpose of the network is two-fold: (1) to establish a baseline of background microseismic activity prior to completion and testing of the well, and (2) to determine if the well activity induces changes in the rate of local micro-seismicity. This report describes the installation and operation of the seismic monitoring network and the results obtained through March, 1982.

TITLE: ***Aromatic Hydrocarbons Associated with Brines from Geopressured Wells***
SUBTITLE: ***Annual Report-1989, 1990, 1991 (3 reports total)***
{Three reports are combined because they are continuation of same study through time.}
AROMATIC HYDROCARBONS ASSOCIATED WITH BRINES FROM GEOPRESSURED WELLS

AUTHORS: Keeley, Dean and John Meriwether
PUBLISHER: U.S. L. Acadiana Research Laboratory
PAGINATION: 20, 30, 79; respectively
PUBLICATION DATE: 1989, 1990, 1991
SPONSOR: DOE
REPORT OR CONTRACT#:DE-AS07-83NV10338
DESCRIPTORS: Cryocondensates, Aliphatic oils, and Well brines

SCOPE:

Samples of cryocondensates--materials condensed at -78.5°C--were taken on a regular basis from the gas stream from the US DOE geopressured wells. Most of the data are from the Gladys McCall, as it has flowed on a regular and almost continuous basis. The cryocondensates are almost exclusively aromatic hydrocarbons, primarily benzene, toluene, ethyl benzene, and the xylenes, but contain over 95 compounds, characterized using gas chromatography-mass spectroscopy.

The yield of the cryocondensates from the Gladys McCall well is steadily increasing as a function of the production volume--from 22.5 to 38.3 micro liters/liter (pL/L) of brine during the production of 6.35 million barrels of brine.

TITLE: ***Assessment of Low-Temperature Geothermal Resources of the United States-1982***
SUBTITLE: ***Geological Survey Circular 892***

AUTHORS: Reed, Marshall-- **EDITOR**
PUBLISHERS : U.S. Geological Survey U.S. Department of Interior and DOE
PAGINATION: 73
PUBLICATION DATE: 1982
SPONSOR: U.S. Geological Survey U.S. Department of Interior and DOE
REPORT OR CONTRACT#: not given

DESCRIPTORS: Low-temperature geothermal resources and Regional heat flow

AUTHOR'S ABSTRACT:

The geothermal-resource assessment presented here is the first quantitative estimation of the thermal energy recoverable from low-temperature (less than 90°C) geothermal systems within the United States.

This assessment, based on data available through April 1982, includes estimates of accessible resource base (geothermal energy in the ground), resource (energy that might be recoverable at the surface), and beneficial heat (energy that might be usable in a specific application). The minimum temperature for low-temperature geothermal resources was defined as 10°C above the mean annual air temperature at the surface and increasing by 25°C/km with depth. Systematic variations in heat flow and temperature gradient permitted the division of the United States into western, central, and eastern regions; within each of these regions, the low-temperature geothermal resources were divided into hydrothermal-convection and conduction-dominated systems.

Quantitative estimates were made for the geothermal energy available in undiscovered as well as identified systems, and the results are tabulated by region, State, and geologic province. Identified low-temperature geothermal systems in the United States contain an accessible resource base of 27 x 10^{21} J a resource of 87 x 10^{18} J, and a beneficial heat of 41 GW_t for 30 years. Undiscovered low-temperature geothermal systems are estimated to contain an additional accessible resource base of 7.2 x 10^{21} J, a resource of 66 x 10^{18} J, and a beneficial heat of 30 Gw_t for 30 years.

TITLE: ***A Summary of the Geothermal and Methane Production Potential of U.S. Gulf Coast Geopressured Zones From Test Well Data***

AUTHORS: Swanson, R.K., W.J. Bernard, and J.S. Osoba
PUBLISHERS: Southwest Research Institute, Louisiana State University, and Texas A&M University
JOURNAL: Journal of Petroleum Technology
PAGINATION: 6
PUBLICATION DATE: December 1986
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: Geopressured sediments, Production problems, Fluid disposal, Temperature, Dissolved solids, Reservoir quality and deliverability, and Gas content

SCOPE:

Extensive testing in 12 wells in Texas and Louisiana has produced a significant body of production and test data from the U.S. gulf coast geopressured zones. Results indicate that these deep sediments contain some reservoir-quality sandstones capable of extended production of moderately hot brine saturated with dissolved natural gas. The best of the test wells to date the U.S. DOE Pleasant Bayou Well 2 in Brazoria County, TX., flowed at a sustained rate of about 18,000 B/D [2860 m^3/d] for about 7 months. The reservoir may cover an area as large as 58 sq miles [150 km^2]. None of the other 11 wells equaled the performance of the Pleasant Bayou test. From an economic standpoint, dissolved methane shows little promise of competitive performance in the foreseeable future. As a geothermal energy source, the temperatures are disappointingly low. The resource overall appears to be large but diffuse.

TITLE: ***Air Monitoring Report For The University of Texas Bureau of Economic Geology***
SUBTITLE: ***March 1980 Report No. 25***

AUTHORS: not given
PUBLISHER: Radian Corporation
PAGINATION: 25
PUBLICATION DATE: March 1980
SPONSOR: Bureau of Economic Geology University of Texas at Austin
REPORT OR CONTRACT#: DCN 80-120-212-27
DESCRIPTORS: Air quality instrumentation and Data acquisition system

SCOPE:

Radian Corporation was under contract to the University of Texas, Bureau of Economic Geology, to provide ambient air quality monitoring at one site near Chocolate Bayou, Texas. This site measured and recorded concentrations of sulfur dioxide, hydrogen sulfide, methane, and particulates. A bag sample was collected bi-weekly and returned to Radian's Austin facilities and analyzed for methane. A description of the instrument used and results of analysis were included in this report.

TITLE : ***An Assessment of Precise Surface Gravity Measurements for Monitoring the Response of a Geothermal Reservoir to Exploitation***

SUBTITLE: ***Geothermal Subsidence Research Management Program***

AUTHORS: Grannell, R. B., J. H. Whitcomb, P.S. Aronstam, and R.C. Clover
PUBLISHERS: Earth Sciences Division Lawrence Berkeley Laboratory
PAGINATION: 105
PUBLICATION DATE: June 1981
SPONSOR: DOE
REPORT OR CONTRACT#: W-7405-ENG-48
DESCRIPTORS: Gravity method, Gravity surveys, and Geothermal regime

SCOPE:

This study constitutes an assessment of the utility of repetitive gravity measurements in monitoring elevation and mass changes due to production in a geothermal field.

Elevation changes occur in the form of subsidence. Its major cause is an increase in effective stress in producing zones due to fluid withdrawal and loss of buoyant support. This subsidence may not occur immediately, and may be triggered by earthquakes. Subsidence of lesser magnitude may be due to thermal contraction. Regardless of the source, subsidence causes an increase in gravity values.

Mass changes occur because of fluid withdrawal in the absence of natural or artificial recharge, or from changes in density due to local solution or precipitation of minerals, or from phase changes in the system with consequent repositioning of mass. Fluid withdrawal, the most important mass change, causes a decrease in gravity values.

TITLE: ***An Integrated Approach to Reservoir Engineering at Pleasant Bayou Geopressured-Geothermal Reservoir***

AUTHORS: Shook, Michael G.
PUBLISHER: Idaho National Engineering Lab -EG&G Idaho , Inc.
PAGINATION: not given
PUBLICATION DATE: December 1992
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Reservoir engineering, Geopressured-geothermal reservoir, and Pressure transient test analysis

AUTHOR'S ABSTRACT:

A numerical model has been developed for the Pleasant Bayou Geothermal- Geopressured reservoir. This reservoir description is the result of integration of a variety of data, including geological and geophysical interpretations, pressure transient test analyses, and well operations. Transient test analyses suggested several enhancements to the geologic description provided by University of Texas Bureau of Economic Geology (BEG), including the presence of an internal fault not previously identified. The transient tests also suggested water influx from an adjacent aquifer during the long-term testing of Pleasant Bayou; comparisons between transient test analyses and the reservoir description from BEG suggests that this fault exhibits pressure-dependent behavior. Below some pressure difference across the fault, it remains a no-flow barrier; above this threshold pressure drop the barrier fails, and fluid moves across the fault.

A history match exercise is presented, using the hypothesized "leaky fault." Successful match of 4 years of production rates and estimates of average reservoir pressure supports the reservoir description developed herein. Sensitivity studies indicate that the degree of communication between the perforated interval and the upper and lower sands in the reservoir (termed "distal volume" by BEG) impact simulation results very little, whereas results are quite sensitive to storage and transport properties of this distal volume. The prediction phase of the study indicates that Pleasant Bayou is capable of producing 20,000 STB/d through 1997, with the final bottomhole pressure approximately 1600 psi above abandonment pressure.

TITLE: ***An Energy Based Approach to Natural Resource Analysis: Theory and Application to Geopressured Gas Resources in the U.S. Gulf Coast Region***
SUBTITLE: ***A Thesis***

AUTHORS: Cleveland, Cutter John
PUBLISHER: Louisiana State University
PAGINATION: 130
PUBLICATION DATE: December 1982
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured gas, Quality of fuel energy, and Subsidence

AUTHOR'S ABSTRACT:

The production of economic output requires the use of energy to transform natural resources into goods and services. Traditional models of the economic process do not include the mechanisms by which natural resource quality and availability constrain human economic activities. Declining fuel energy quality erodes the ability of society to maintain or expand production.

An alternate method of analyzing economic activity was developed based on how changes in natural resource quality and availability affect the economy. The quality of fuel energy resources is emphasized as a critical parameter that limits the extraction of other natural resources as well as the production of goods and services. Declining fuel quality was shown to contribute to adverse economic conditions such as decreased economic output, declining labor productivity, increased inflation rates, and increased investment in the energy sector of the economy.

The methods of net energy calculations were applied to the technology of extracting geopressured gas resources in the U.S. Gulf Coast region. Net energy yields for methane gas from a single geopressured well system ranged from 0.2 to 6.0 trillion BTU over a twenty year period. Net energy ratios ranged from the energy breakeven point to about 5 to 1 in the most optimistic case. Conventional deep gas wells in southern Louisiana yield significantly more methane energy per well compared to geopressured wells. Energy costs of land subsidence may negate most of the net yield from a geopressured well if subsidence occurs in areas already experiencing high rates of land loss.

TITLE: ***Annual Report 1974***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHOR: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1974
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:

Summary Publications Report for year 1974

Projects Summarys

Evaluation of Geothermal Resources of the Texas Gulf Coast.

TITLE: ***Annual Report 1976***

SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHOR: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLISHING DATE: 1976
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:

Summary Publications Report for year 1976

Projects Summarys

Reconnaissance Geothermal Resource Assessment of the Rio Grande Valley, Trans-Pecos Texas

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TITLE: ***Annual Report 1977***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHOR: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1977
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

Summary Publications Report for year 1977

Projects Summarys

Regional Assessment and Site Selection of the Geopressured Geothermal Resource, Texas Gulf Coast

Texas' First Geothermal Well Site Selected.

Geopressured Geothermal Energy Development-Program Plan for Environmental Baseline Studies

Environmental Analysis of Geopressured Geothermal Prospect Areas, Texas Gulf Coast

Environmental Monitoring Geopressured Geothermal Test Well, Brazoria County

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TITLE: ***Annual Report 1978***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***
Bureau of Economic Geology The University of Texas at Austin

AUTHOR: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1978
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1978

Projects Summarys

Resource Assessment and Test Well Site Selection of the Geopressured Geothermal Resource, Texas Gulf Coast

Volume and Accessibility of Entrained Methane in Deep Geopressured Reservoirs- Tertiary

Formations of the Texas Gulf Coast.

Effects of a Geopressured Geothermal Subsurface Environment on the Elastic Properties of Texas Gulf Coast Sandstones and Shales

Regional Assessment and Prospective Site Analysis of the Geothermal Potential along the Balcones, Luling-Mexia-Talco systems Central Texas

Geopressured Geothermal Energy Development-Program Plan for Environmental Baseline Studies

Environmental Monitoring Geopressured Geothermal Test Well, Brazoria County

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TITLE: ***Annual Report 1979***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1979
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1979

Projects Summarys

Volume and Accessibility of Entrained Methane in Deep Geopressured Reservoirs- Tertiary Formations of the Texas Gulf Coast.

Effects of a Geopressured Geothermal Subsurface Environment on the Elastic Properties of Texas Gulf Coast Sandstones and Shales

Geological Studies of Geopressured Zones

Geothermal Resource Assessment for the State of Texas

Regional Assessment and Prospective Site Analysis of the Geothermal Potential along the Balcones, Luling-Mexia-Talco systems Central Texas

Potential for Geopressured Geothermal Energy, Wilcox Group, Texas Gulf Coast

Geopressured Geothermal Energy Development-Program Plan for Environmental Baseline Studies

Environmental Analysis of Geopressured Geothermal Prospect Areas, Texas Gulf Coast

Environmental Monitoring Geopressured Geothermal Test Well, Brazoria County

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TITLE: ***Annual Report 1980***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1980
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1980

Projects Summarys

Geologic Studies of Geopressured and Hydropressured Zones in Texas

Resource Assessment and Test Well Site Selection of the Geopressured Geothermal Resource, Texas Gulf Coast

Volume and Accessibility of Entrained Methane in Deep Geopressured Reservoirs- Tertiary Formations of the Texas Gulf Coast.

Hueco Tanks Geothermal Area

TITLE: ***Annual Report 1981***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***
AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1981
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTIONS: N/A

SCOPE:
Summary Publications Report for year 1981

Projects Summarys

Geologic Studies of Geopressured and Hydropressured Zones in Texas

Continuity of Geopressured Reservoirs

Resource Assessment and Test Well Site Selection of the Geopressured Geothermal Resource, Texas Gulf Coast

Geothermal Resource Assessment for the State of Texas

Environmental Monitoring Geopressured Geothermal Test Well, Brazoria County

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TITLE: ***Annual Report 1982***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given

PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1982
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1982

Projects Summarys

Geothermal Resource Assessment for the State of Texas

Environmental Monitoring Geopressured Geothermal Test Well, Brazoria County

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TITLE : ***Annual Report 1983***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1983
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1983

Projects Summarys

Geothermal Resource Assessment for the State of Texas

Resource Assessment and Seismic Studies - Geopressured Geothermal Energy, Texas Gulf Coast

Integration of Geological and Fluid Data in the Geopressured Gulf Coast Basin

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TITLE: ***Annual Report 1984***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1984
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1984

Projects Summarys

Consolidation of Geologic Studies of Geopressured Geothermal Resources in Texas

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TITLE: ***Annual Report 1985***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given

PUBLICATION DATE: 1985
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1985

Projects Summarys

Consolidation of Geologic Studies of Geopressured Geothermal Resources in Texas

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TITLE: ***Annual Report 1987***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1987
SPONSOR: DOE
REPORT OR CONTRACT #:not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1987

Projects Summarys

Consolidation of Geologic Studies of Geopressured Geothermal Resources in Texas

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TITLE: ***Annual Report 1988***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1988
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1988

Projects Summarys

Geologic Studies of Geopressured Geothermal Resources in Texas

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TITLE: ***Annual Report 1989***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1989
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1989

Projects Summarys

Development of an Integrated Hydrogeologic and Hydrochemical Model of the Department of Energy Pleasant Bayou Geopressured-Geothermal Test Well No. 2
Brazoria County, Texas

TITLE: ***Annual Report 1992***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1992
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1992

Projects Summarys

Assessment of Oil, Natural Gas, and Geothermal Energy Production in Texas.

Consolidated Research Program: U.S. Gulf Coast Geopressured Geothermal Program

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TITLE: ***Annual Report 1993***
SUBTITLE: ***Bureau of Economic Geology The University of Texas at Austin***

AUTHORS: not given
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: 1993
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: N/A

SCOPE:
Summary Publications Report for year 1993

Projects Summarys

Consolidated Research Program: U.S. Gulf Coast Geopressured Geothermal Program

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TITLE: ***Annual Report Volume I***
SUBTITLE: ***Environmental Baseline Monitoring in the Area of General Crude Oil - Department of Energy Pleasant Bayou Number 2-A Geopressured Geothermal Test Well***

AUTHORS: Gustavson, Thomas, Rory C. Howard, and Douglas McGookey
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 61
PUBLICATION DATE: 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-77ET28504
DESCRIPTORS: Air quality, Water quality, and Microseismic monitoring

SCOPE:
A program to monitor baseline air and water quality, subsidence, microseismic activity, and noise in the vicinity of Brazoria County geopressured geothermal test wells, Pleasant Bayou #1 and #2, has been underway since March 1978. This report continues the description of baseline air and water quality of the test well site, includes an inventory of microseismic activity during 1979 with interpretations of the origin of the events, and discusses the installation and monitoring of a liquid tilt meter at the test well site. In addition, a brief description of flooding at the test site is presented.

TITLE: ***Annual Report Volume II***
SUBTITLE: ***Environmental Baseline Monitoring in the Area of General Crude Oil - Department of Energy Pleasant Bayou Number 2-A Geopressured Geothermal Test Well***

AUTHORS: Gustavson, Thomas C., Rory C. Howard, and Douglas McGookey
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 245

PUBLICATION DATE: 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-777ET28504
DESCRIPTORS: Air quality monitoring and Methane bag sampling

SCOPE:

Radian Corporation is under contract to the University of Texas, Bureau of Economic Geology, to provide ambient air quality monitoring at one site near Chocolate Bayou, Texas. This report describes site measurements and records of concentrations for sulfur dioxide, hydrogen sulfide, methane, and particulates. A bag sample is collected bi-weekly and returned to Radian's Austin facilities and analyzed for methane.

TITLE: ***Annual Progress Report Gladys McCall Geopressured Design Well for the period Oct 1, 1980 to September 30, 1981***
SUBTITLE: ***T-F&S/Doe Gladys McCall No.1 Cameron Parish, Louisiana***
AUTHORS: not given
PUBLISHER: Technadril-Fenix & Scisson
PAGINATION: 21
PUBLICATION DATE: December 1982
SPONSOR: DOE
REPORT OR CONTRACT #: DE-AC08-80ET27217
DESCRIPTORS: Significant problems, Future problems, and Gladys McCall Site

SCOPE:

This report documents the progress of Gladys McCall Geopressured Design Well from October 1, 1980 to September 30, 1981. Included in this report are financial summaries, site descriptions, problems, and future plans.

TITLE: ***Aromatic Hydrocarbons Associated With Brines From Geopressured Wells***
SUBTITLE: ***August 1983-December 1989 Final Report***

AUTHORS: Keeley, Dean and John Meriwether
PUBLISHER: Acadiana Research Laboratory University of Southwestern Louisiana
PAGINATION: not given
PUBLICATION DATE: 1990
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Cryocondensates, Aliphatic oils, and pH

SCOPE:

This report determines the concentration of the cryocondensates in fluids of the various US DOE Geopressured wells as a function of production volume, correlates the production of these compounds with reservoir and well production characteristics, and measures solubilities of cryocondensates components in water and sodium chloride solutions (brines) as a function of ionic strength and temperature and the component's distribution coefficients between these solutions and oil.

TITLE: ***Annual Report Volume III (continued)***
Environmental Baseline Monitoring in the Area of General Crude Oil- Department of Energy Pleasant Bayou Number 1- A Geopressured-Geothermal Test Well-1978
SUBTITLE: ***Appendix II: Air Quality Monitoring Radian Corporation Austin, Texas***

AUTHORS: Gustavson, Thomas
CORPORATE AUTHORS: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 137
PUBLICATION DATE: 1979
SPONSOR: DOE
REPORT OR CONTRACT#: DE-S05-77ET27031
DESCRIPTORS: Air quality instrument systems, Bag sampling, and Operating time analysis

SCOPE:

A collection of reports prepared by Radian Corporation Staff from September 1978, January 1979, and February 1979 that provide ambient air quality monitoring at one site near Chocolate Bayou, Texas. Concentrations of sulfur dioxide, hydrogen sulfide, methane, and particulates were measured and recorded.

NOTE:
Copies of Vol. 1 & 2 of this report could not be located for this summary report project.

TITLE: ***Brazroia County Re-leveling 1st Order Leveling Pleasant Bayou, TX Geopressure Well Site***

AUTHOR: Vernon F. Meyers and Associates, Inc.
PUBLISHER: Vernon F. Meyers and Associates, Inc.
PAGINATION: 83
PUBLICATION DATE: 1985
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: First order leveling and Subsidence

SCOPE:

This report documents the First Order, Class I, leveling that was conducted to monitor subsidence of previously installed and leveled bench marks, established by the National Geodetic Survey (NGS) and Vernon Meyer and Associates, Inc., in the area of the Pleasant Bayou geopressured test well. All leveling surveys to conformed to NGS Standards and specifications.

TITLE: ***Brine and Gas Production History and Gas Sales T-F S/DOE Gladys McCall No. 1 Cameron Parish, Louisiana, December 1982-September 1985***

AUTHORS: not given
PUBLISHER: Technadril-Fenix & Scisson
PAGINATION: 82
PUBLICATION DATE: 1985
REPORT OR CONTRACT#: DE-AC07-80ET27217
SPONSOR: DOE
DESCRIPTORS: Brine and gas production, Sand zone No. 8 and Sand zone No. 9

SCOPE:

This report includes brine and gas production history of the T-F&S/DOE Gladys McCall No. 1 well from the Initial Flow Test of Sand Zone No. 9, which began on December 16, 1982, through Long-Term Testing of Sand Zone No. 8 during the month of September 1985. Monthly production shutdown logs, which indicate well downtime and the reasons therefor, are also included for the Long-Term Testing Period (December 1983-September 1985) of the reservoir associated with Sand Zone No. 8, as are monthly Gas Sales data for the May 1984 - September 1985 period.

TITLE: ***Brine Chemistry Research Consortium***
SUBTITLE: ***Annual Report (March 1988 - March 1989)***

AUTHORS: Oddo, J.E., E. H. Street, A. T. Kan, M. L. Johnson, and M. B. Tomson
PUBLISHER: Rice Engineering Design and Development Institute
PAGINATION: 134
PUBLICATION DATE: July 1989
REPORT OR CONTRACT#: 5088-212-1717
SPONSOR: Gas Research Institute
DESCRIPTORS: Mechanism of inhibition of nucleation of sparingly soluble salts, Monitoring brine chemistry, Corrosion, Field work design, $FeC0^3$ precipitation kinetics, Solubility and stoichiometry of calcium-diethylenetriaminepenta(methylene phosphate), and Inhibitor squeeze experiments

SCOPE:

Research on brine chemistry and methods to control adverse chemical reactions during production of natural gas has been funded by GRI at Rice University since 1981. The majority of the field and laboratory research has been directed toward the efficient control of scale and corrosion. The research has been divided between field testing and laboratory backup research. In all cases research has been done with generic inhibitors, so that progress could be transferred from one field site to another. In addition, some progress has been made toward understanding the theory of scale formation, corrosion control and their interrelationship.

TITLE: ***Brine Disposal Options For Geopressured Methane Development***
SUBTITLE: ***Annual Report For 1982***

AUTHORS: Tatom, Frank B. and Michael W. Mullen
PUBLISHER: Engineering Analysis, Inc. and Science Applications, Inc.
PAGINATION: 208
PUBLICATION DATE: December 1982
SPONSOR: Gas Research Institute
REPORT OR CONTRACT#: 5081-351-0530
DESCRIPTORS: Conventional oil and gas disposal, Strategic petroleum reserve brine disposal, Engineering problems, Environmental constraints, and Economic factors

SCOPE:

Advances in methods for recovering unconventional natural gas are expected to significantly impact future domestic natural gas production. Within the geopressured zone in the Gulf of Mexico basin, large volumes of moderately to heavily saline waters occur trapped in aquifers deep within the sedimentary units, at temperatures which may exceed 300°F. These saline-water zones contain varying amounts of dissolved methane representing recoverable reserves that have been estimated to be as high as 2,000 trillion cubic feet. For each 28 standard cubic feet of gas recovered, however, approximately one barrel of brine is produced. Disposal of such production brines involves a variety of environmental, engineering, and economic issues which must be resolved before geopressured methane production can proceed.

The objectives of this project were (1) to examine the state of the art for brine disposal from Gulf Coast conventional oil and gas operations, as well as from the Department of Energy (DOE) Strategic Petroleum Reserve (SPR) program; (2) to identify economic, engineering, and environmental problems associated with the various disposal options; and (3) to develop the optimum disposal strategy for brine disposal from geopressured methane recovery operations.

TITLE: ***Brine Chemistry and Control of Adverse Chemical Reactions With Natural Gas Production***
SUBTITLE: ***Annual Report (January 1989- June 1990)***

AUTHORS: Oddo, J. E., A. T. Kan, X. Cao, L. Yan, M. L. Johnson, and M. B. Tomson
PUBLISHER: Gas Research Institute
PAGINATION: 118
PUBLICATION DATE: August 1990
SPONSOR: Gas Research Institute
REPORT OR CONTRACT #: 5088-212-1717
DESCRIPTORS: Scale formation, Carbon Dioxide corrosion, and Solids and turbidity

production

SCOPE:

GRI sponsors concepts which attempt to recover significantly more of the fraction of the gas remaining in place after a field has "Watered out." This requires the production and disposal of large volumes of brine. Three chemistry problem associated with this brine are: 1.) Scale formation; 2.) Carbon dioxide corrosion; 3.) Solids or turbidity production. Most of our work during the previous year has focused on the first two or three problems.

Scale has been controlled in the Hitchcock gas field near Galveston, Texas, by injecting inhibitors down 1/4 in. OD stainless steel treat strings. Cost effective 316 SS was used instead of conventional high alloys. This has saved over one-hundred thousand dollars on this field alone. It is planned to compare the economics of treat strings with that the fate of inhibitors in core materials, both of which relate to optimizing inhibitor squeeze design.

The use of managed scaled control for corrosion inhibition is being tested in the laboratory by examining the dynamics of iron carbonate formation and in the field by injecting phosphate in online slip streams.

TITLE: ***Brine and Gas Recovery From Geopressured Systems: I. Parametric Calculations***
SUBTITLE: ***Preliminary Report***

AUTHORS: Garg, S. K.
PUBLISHER: S-Cubed
PAGINATION: 60
PUBLICATION DATE: June 1983
SPONSOR: DOE Nevada Operations Office
REPORT OR CONTRACT #: DE-AC08-80-NV10150
DESCRIPTORS: Parametric calculations, MUSHRM, Permeability, Pore fluid gas content, and Shale recharge

AUTHOR' S ABSTRACT:

A series of parametric calculations was run with the S-CUBED geopressured geothermal simulator MUSHRM to assess the effects of important formation, fluid and well parameters on brine and gas recovery from geopressured systems. The specific parameters considered are formation permeability, pore fluid salinity, temperature and gas content, well radius and location with respect to reservoir boundaries, desire flow rate, and possible shale recharge. It was found that the total

brine and gas recovered (as a fraction of the resource in situ) are most sensitive to formation permeability, pore fluid content, and shale recharge.

TITLE: ***Chemical Analyses of Ground Water for Saline-Water Resources Studies in Texas Coastal Plain Stored in National Water Data Storage and Retrieval System***
SUBTITLE: ***Open File Report 75-79 Volumes I & II***

AUTHORS: Taylor, R.E.
PUBLISHERS: United States Department of the Interior Geological Survey
PAGINATION: 669, Map
PUBLICATION DATE: March 1975
SPONSOR: U.S. States Department of the Interior Geological Survey
REPORT OR CONTRACT #: not given
DESCRIPTORS: Chemical analysis and Data bank

AUTHOR'S ABSTRACT:

Chemical Analyses of 4,269 water samples from wells in 66 counties in Texas have been processed into the National Water Data Storage and Retrieval System by the Gulf Coast Hydrogeology Project of the U. S. Geological Survey. More than 65,000 chemical Analyses of saline waters produced by oil test and production wells have been contributed to the project by major oil companies. The computerized tabulation and the computer-drawn map of the locations of sampling sites are the initial release of oil company, State, and Federal data in Texas Coastal Plain from the data bank.

TITLE: ***Comment Response Document For Geothermal Research Objectives***

AUTHORS: Jelacic, Allan and Daniel Entingh--**EDITORS**
PUBLISHERS: Geothermal Technology Division DOE
PAGINATION: 28
PUBLICATION DATE: October 1988
SPONSOR: DOE and Meridian Corporation
REPORT OR CONTRACT #: not given
DESCRIPTORS: Research analysis, Hydrothermal objectives, IM-GEO model, Geopressured research objectives, Hot dry rock research objectives, and Magma research objectives

SCOPE:

On April 14, 1988, the Geothermal Technology Division (GTD), U.S. Department of Energy, released for review the draft report "Statement of Programmatic Objectives of the Geothermal Technology Division". Prior to general distribution, GTD sent the report to a small number of research managers and geothermal industry representatives, with a request for comments and suggestions.

This document is the "Comment Response Document" for the "Geothermal Objectives" report. It contains (1.) a compilation of the major comments, criticisms, and suggestions received from the reviewers. (2.) GTD's responses to those comments, in the form of actions that will be taken or reasons why actions can not or should not be taken on some specific points.

The purpose of the document is to inform the reviewers that their comments have been noted and the actions that will occur due to their suggestions.

Comments were reviewed and collated into major categories. Most comments are quoted verbatim, but some have been edited to smooth the reading and clarify the substance. Some detailed comments have been omitted here, but referred instead to the cognizant GTD Headquarters R&D manager for consideration.

The general format presents one or more "COMMENTS" for each category, with a unique identifier for each reviewer at the end, followed by a "RESPONSE" to those comments. Reviewers should be able to recognize their identifier to find responses to specific comments.

TITLE: ***Consolidation of Geologic Studies of Geopressured/Geothermal Resources in Texas***
SUBTITLE: ***1982 Annual Report***

AUTHORS: Morton, R. A., T. E. Ewing, W. R. Kasier, and R. J. Finley
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 195
PUBLICATION DATE: March 1983
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: DE-AC08-79ET27111
DESCRIPTORS: Frio Growth-Fault trend and Tertiary formation waters

SCOPE:

This report contains detailed studies on the geology, chemical compositions, diagenetic origin, reservoir quality, and geopressured geothermal resources within the Frio formation of the Texas Gulf coast.

TITLE: ***Consolidation of Geologic Studies of Geopressured Geothermal Resources in Texas***

SUBTITLE: ***Barrier Bar Tidal Channel Reservoir Facies Architecture, Jackson Group, Prado Field, South Texas Final Report***

AUTHORS: Seni, Steven and Suk Joo Chooh
PUBLISHERS: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 54
PUBLICATION DATE: September 1993
SPONSOR: DOE-Advanced Technologies Division
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Prado field, Production history, and Geologic characterization

AUTHOR'S ABSTRACT:

Sandstone reservoirs in the Jackson barrier/strandplain play are characterized by low recovery efficiencies and thus contain a large hydrocarbon resource target potentially amenable to advanced recovery techniques. Prado field, Jim Hog County, South Texas, has produced over 23 million bbl of oil and over 32 million mcf gas from combination structural-stratigraphic traps in the Eocene lower Jackson Group. Hydrocarbon entrapment at Prado field is a result of anticlinal nosing by differential compaction and updip pinch-out of barrier bar sandstone. Relative base-level lowering resulted in forced regression that established lower Jackson shoreline sandstones in a relatively distal location in central Jim Hog County. Reservoir sand bodies at Prado field comprise complex assemblages of barrier-bar, tidal-inlet fill, back-barrier bar, and shoreface environments. Subsequent progradation built the barrier-bar system seaward 1 to 2 mi. Within the barrier-bar system, favorable targets for hydrocarbon reexploration are concentrated in tidal-inlet facies because they possess the greatest degree of depositional heterogeneity.

TITLE: ***Consolidation of Geologic Studies of Geopressured Geothermal Resources in Texas***
SUBTITLE: ***1989 Annual Report***

AUTHORS: Kreitler, C.W., R.M. Capuano, M.S. Akhter, H.S. Mamlin, and T. G. Walter, M.E. Walter
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 241
PUBLICATION DATE: May 1990
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Reservoir description of Pleasant Bayou Fault Block, Geology, and Hydrogeology

AUTHOR'S ABSTRACT:

The objective of the current studies at the Pleasant Bayou geopressured geothermal reservoir in Brazoria County, Texas, was to evaluate the resource base and long-term performance. The approach was to develop an integrated understanding of the hydrogeology of the reservoir and the hydrochemistry of the produced brine. Such an understanding would allow determination of the extent of lateral and vertical hydrologic continuity of the target zone and to identify the sources of brine being produced from the geopressured reservoir.

The current phase of long-term production testing of the Frio C-zone at Pleasant Bayou Well No. 2 began in May 1988. During the past 16 months of production, nearly 6.8 million barrels of brine and 162.2 million cubic feet of gas have been produced and a relatively small (less than 300 psi) drop-in bottom-hole pressure has been observed at sustained producing rates of between 15,000 and 20,000 barrels per day. Earlier geologic studies have estimated the effective pore volume of the C-zone in the neighborhood of 6.2 to 6.6 billion barrels. Analysis of pressure and production data from current testing indicates that the limits of the geo-pressured reservoir at Pleasant Bayou have not been reached, that is, either the size of the reservoir could be larger than anticipated or there could be a continuous influx of waters from other geopressured sources that sustains the reservoir energy at Pleasant Bayou. Geochemical testing has proved inconclusive in identifying other sources of water partly because of the variability of chemical composition within the produced zone.

Evaluation of reservoir performance at active oil and gas fields in the immediate vicinity of the Pleasant Bayou fault block has not provided evidence of direct hydrologic communication between the geopressured aquifer and the overlying hydrocarbon reservoirs. The pattern of depletion in these oil and gas fields reflects some characteristic features that may become evident in Pleasant Bayou over a long period of production. Moreover, additional refinement of the Integrated hydrogeologic-hydrochemical model is possible either through prolonged testing at Pleasant Bayou No. 2 well or through drilling and testing of additional wells in the Pleasant Bayou fault block. Determining the nature of bounding faults around the test well will require additional seismic data as well as multi well testing of the reservoir.

TITLE: ***Consolidation of Geologic Studies of Geopressured/Geothermal Resources in Texas***
SUBTITLE: ***1984 Annual Report***

AUTHORS: Ewing, T. E., M. P. R. Light, N. Tyler, and R. A. Morton
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 97
PUBLICATION DATE: March 1986
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: DE-AC08-79ET27111
DESCRIPTORS: Wilcox trend and Frio trend

SCOPE:

This final report contains two sections. Section I presents the conclusion of work under the "Resource Assessment and Seismic Studies" project topic. It ties together the prospect and study areas described previously with a regional statistical survey of fault compartments. Section II reports the conclusion of the "Synthesis of data" project topic. New vitrinite reflectance and hydrocarbon data are combined with previous information to yield a revised theory of fluid migration and temperature history in the vicinity of the Pleasant Bayou test-well site.

TITLE: ***Consolidation of Geologic Studies of Geopressured-Geothermal in Texas***
SUBTITLE: ***1990 Annual Report***

AUTHORS: Raney, J.A., S.J. Seni, J.R DuBar, and T. G. Walter
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 61
PUBLICATION DATE: March 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Characterization of deep Wilcox geothermal reservoirs, Jackson group heavy-oil reservoirs, Heavy oils, and Hot-water drive

THIS REPORT IS DIVIDED INTO TWO SECTIONS: *Colocation of Geothermal and Heavy-Oil Reservoirs: A South Texas Update* and *Hot-Water Flooding: Its Role in the Mobilization of Heavy Oil*

AUTHOR'S ABSTRACT:

Colocation of Geothermal and Heavy-Oil Reservoirs: A South Texas Update

In a five-county area of South Texas, geopressured-geothermal reservoirs in the upper Wilcox Group are co-located with heavy-oil reservoirs in the overlying Jackson Group. In 1990, research at the Bureau of Economic Geology concentrated on evaluating the potential of using geopressured-geothermal water for hot-water flooding of heavy oil reservoirs. Favorable geothermal reservoirs are defined by thick deltaic sandstones and growth-fault-bounded compartments. Potential geothermal reservoirs are present at a depth of 11,000 fl (3,350 m) to 15,000 fl (4,570 m) and contain water at temperatures of 350°F (177°C) to 383°,F (195°C) in Fandango field, Zapata County. One potential geothermal reservoir sandstone in the upper Wilcox (R sandstone) is composed of a continuous sand body 100 ft (30 m) to greater than 200 fl (>61 m) thick. Fault blocks average 2 to 4 mi^2 (5.2 to 10.4 km^2) in area.

Both heavy-oil (average API=19) and light-oil (average API=26) reservoirs in South Texas are

present in sandstones of the Jackson Group Mirando trend. The updip pinch-out of strike-oriented sheet sandstones in the Jackson Group largely controls the distribution of Mirando-trend heavy-oil reservoirs. The lateral continuity of heavy-oil reservoirs minimizes reservoir compartmentalization, which could disrupt injected-fluid flow paths.

Geologic and engineering research that still needs to be conducted includes (1) studies of the chemical compatibility between injected geothermal fluids and clay matrix of heavy-oil reservoirs, (2) detailed field studies of geometry and size of geothermal reservoirs, (3) detailed field studies of geometry and size of heavy-oil reservoirs, and (4) studies of changes in the temperature and chemistry of geothermal) fluids when injected into heavy-oil reservoirs.

AUTHOR'S ABSTRACT:

Hot-Water Flooding: Its Role in the Mobilization of Heavy Oil

The effectiveness of hot-water flooding as a mechanism for improved recovery in heavy-oil reservoirs was investigated through a literature survey. There have been relatively few field applications designed to assess the effectiveness of hot-water floods to improve recovery from heavy-oil reservoirs. Hot-water flooding of heavy-oil reservoirs is more effective than conventional isothermal water flooding, but markedly less efficient than steam for recovery of heavy-oil. Hot water improves recovery of heavy oil through a variety of poorly understood displacement mechaisms including (1) thermal expansion, (2) viscosity reduction, (3) decreased wettability, and (4) reduced oil/water tension. Improvement in recovery of viscous crudes by hot-water floods relative to conventional isothermal water floods may be largely\ due to (1) the improvement of oil mobility through reduction of oil viscosity and (2) reduction in residual oil at high temperatures. The economic disadvantages of hot-water flooding would be substantially mitigated if an ample supply of relatively inexpensive geopressured-geothermal waters was located near heavy-oil reservoirs.

TITLE: ***Consolidated Research Program United States Gulf Coast Geopressured-Geothermal Program***
SUBTITLE: ***1990 Annual Report***

AUTHORS: Dorfman, Myron H., Henry F. Dunlap, Kenneth E. Gray, Mark A. Miller, Kamy Sepehrnoori, J.A Raney,. J.R DuBar, S.J. Seni, and T. G. Walter
PUBLISHERS: Department of Petroleum Engineering and Bureau of Economic Geology University of Texas at Austin
PAGINATION: 129
PUBLICATION DATE: July 1991

SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: N/A

SCOPE:

This report is a collection of several annual reports for the year of 1990. The topics covered in this report include logging research, geopressured-geothermal information systems, compaction and tensile testing of geopressured-geothermal reservoir rock, consolidation of geologic studies of geopressured-geothermal resources in Texas, and well test analysis and improved models for geopressured-geothermal systems.

TITLE: ***Consolidated Research Program United States Gulf Coast Geopressured-Geothermal Program***
SUBTITLE: ***Logging Research Final Report 1979-1992***

AUTHORS: Dunlap, Henry F.
PUBLISHERS: Department of Petroleum Engineering University of Texas
PAGINATION: 84
PUBLICATION DATE: June 1992
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Salinity prediction, radioactive bullet logging, rock wettabilitly, rock stress, thermal neutron, and boron

AUTHOR'S ABSTRACT:

The logging research program in the DOE Geopressured-Geothermal Energy Project was set up to (a) carry out research on logging problems important to the DOE program; (b) provide advice on logging programs in DOE wells; (c) monitor log quality during data acquisition; (d) provide log analyses as requested by DOE and (e) provide other services as skills and time permit. Funding for the project amounted to about $50,000/year from 1979 to 1985 (direct cost plus overhead). In 1986 DOE funding began to increase and was about $100,00{} per year for the last three years of the project (1988-91). In addition to DOE funding, the Gas Research Institute Tight Gas Sands Project contributed to our boron research by about $7,000 per year during 1989-91, plus about $100,000 worth of core and log data from five tight gas sand wells in East and West Texas and in Wyoming.

TITLE: ***Consolidation of Geologic Studies of Geopressured/Geothermal Resources in Texas***
SUBTITLE: ***1982 Annual Report***

AUTHORS: Morton, R. A., T. E. Ewing, W. R. Kasier, and R. J. Finley
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 195
PUBLICATION DATE: March 1983
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: DE-AC08-79ET27111
DESCRIPTORS: Frio Growth-Fault trend and Tertiary formation waters

SCOPE:

This report contains detailed studies on the geology, chemical compositions, diagenetic origin, reservoir quality, and geopressured geothermal resources within the Frio formation of the Texas Gulf coast.

TITLE: ***Consolidation of Geologic Studies of Geopressured/Geothermal Resources in Texas***
SUBTITLE: ***1982 Annual Report***

AUTHORS: Ewing, T. E., R. A. Morton, N. Tyler, and M.P.R. Light
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 97
PUBLICATION DATE: March 1986
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: DE-AC08-79ET27111
DESCRIPTORS: Wilcox trend and Frio trend

SCOPE:

This final report contains two sections. Section I presents the conclusion of work under the "Resource Assessment and Seismic Studies" project topic. It ties together the prospect and study areas described previously with a regional statistical survey of fault compartments. Section II reports the conclusion of the "Synthesis of data" project topic. New vitrinite reflectance and hydrocarbon data are combined with previous information to yield a revised theory of fluid migration and temperature history in the vicinity of the Pleasant Bayou test-well site.

TITLE: ***Consolidated Research Program United States Gulf Coast Geopressured-Geothermal Program***
SUBTITLE: ***1991 Annual Report***
PUBLISHER: The Center for Petroleum and Geosystems Engineering and Bureau of Economic Geology University of Texas
PAGINATION: 144
PUBLISHER AND DATE: 1991
SPONSOR: DOE-Advanced Technologies Division
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: N/A

SCOPE:

This report consist of a collection of reports that document the research preformed during 1991. This research includes logging research, reservoir engineering, geopressured-geothermal information system, production stability of geopressured-geothermal reservoirs, and colocation of heavy-oil and geothermal resources in south Texas.

TITLE: ***Deep Basin Investigations North Louisiana Geothermal Resource Assessment***
SUBTITLE: ***SECTION 1 Geologic Assessment and Isothermal Mapping and SECTION 2 Potential Industrial Use of Geothermal Water for Process Heat***

AUTHORS: Pilger, Rex H. Jr. and Fred M. Wrighton
PUBLISHER: Center for Energy Studies Louisiana State University
PAGINATION: 27
PUBLICATION DATE: 1984
SPONSOR: Louisiana Department of Natural Resources
REPORT OR CONTRACT#: 21400-83-28
DESCRIPTORS: Geologic assessment, Isothermal mapping, Geothermal water, Process heat, and Energy-economic analysis

SCOPE:

This report is one of three products resulting from the study funded by the Louisiana Department of Natural Resources. Three isothermal maps accompany this report showing the temperature ranges for the north Louisiana study area at depths of 3000, 6000, and 9000 feet.

This report consists of two sections. Section 1 contains geologic assessment and isothermal mapping methodology and interpretation. Section 2 contains potential industrial use of geothermal

water for process heat.

TITLE: ***Depletion and Recovery Behavior of the Gladys McCall Geopressured Geothermal Reservoir***
SUBTITLE: ***Topical Report***
AUTHORS: Riney, T.D.
PUBLISHER: S-Cubed
PAGINATION: 36
PUBLICATION DATE: June 1990
SPONSOR: DOE and Center for Energy Studies at the University of Texas at Austin
REPORT OR CONTRACT#: DE-FC07-85NV10421
DESCRIPTORS: Recovery phase, Depletion phase, Cross-flow, and Geopressured reservoir

AUTHOR'S ABSTRACT:

Gladys McCall Well No. 1 produced over 27 million barrels of brine and 675 MMscf gas from the thickest sand (Sand Zone 8; 15,158 to 15,490 feet at the test well) from October 7, 1983 through October 29, 1987 when the well was shutin for a long-term pressure buildup test still underway. The test history may be divided into two major phases: a Depletion Phase of over 3.5 years (October 7,1983 through April 21, 1987) and a Recovery Phase currently 3.0 years in duration (April 1987 through present). The flow rate during the Depletion Phase was over 30,000 bbls/day part of the time and averaged $q \sim 19{,}600$ bbls/day. The Recovery Phase consists of a period when the well was held at $q \sim 10$, 040 bbls/day (April 21 to October 29, 1987) followed by the ongoing long-term shutin test. Analysis of the available test data at the end of the Depletion Phase resulted in the construction of a conceptual model of the reservoir, which depends on cross-flow from sands overlying /underlying Sand Zone 8 for the observed pressure maintenance and a reservoir simulation model based on the crossflow concept was developed. The present report presents analysis of more complete data now available. Modification of the earlier reservoir simulation model is found necessary to provide a satisfactory match over the integrated data sets of both the Depletion and Recovery Phases of the test history. The results of this DOE long- term testing of the Gladys McCall well have defined an impressively large geopressured reservoir and improved our understanding of the geopressured resource base.

TITLE: ***Depositional Setting, Structural Style, and Sandstone Distribution in three Geopressured Geothermal Areas, Texas Gulf Coast***
SUBTITLE: ***Annual Report***

AUTHORS: Winker, C.D., R.A. Morton, T. E. Ewing, and D. D. Garcia
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 132
PUBLICATION DATE: October 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE- AC08-79ET27111
DESCRIPTORS: Stratigraphic and paleogeographic setting, Operational stratigraphy, Structural setting, Local structure, Sandstone facies, Pressure distribution, Seismic studies, and Velocity distribution

AUTHOR'S ABSTRACT:

Three areas in the Texas Gulf Coast region with different depositional settings, structural styles, and sandstone distribution were studied with well log and seismic data to evaluate some of the controls on subsurface conditions in geopressured aquifers. Major differences in these subsurface properties make some areas more favorable than others for exploration and development of unconventional gas.

Structural and stratigraphic interpretations were made primarily on the basis of well log correlations. Seismic data confirm the log interpretations but also are useful in structure mapping at depths below well control. Selected seismic sections were reprocessed to improve signal-to-noise ratio, enhance deep reflectors, and suppress multiples; however, not all of the lines benefitted from reprocessing. Those lines that benefitted the least typically had poor signal-to-noise ratio, problems with statics, multiples, or oblique dip orientation that caused further deterioration of the seismic image. Migration proved to be beneficial for fault interpretations. For the most part, velocity variations in these areas are stratigraphically controlled. As a result, the top of geopressure cannot be mapped on the basis of velocity inversion alone.

The Pleasant Bayou area is characterized by a complex structure resulting from salt tectonics superimposed on a greatly expanded and growth-faulted section of the lower Frio Formation. The thickest and most laterally continuous geopressured sandstones were deposited in delta-front or distributary-mouth bar and channel environments of a delta system. The fault block area is large (~25 mi^2) and nearly equidimensional in both strike and dip directions. Sandstone distribution within the fault block varies from patchy to continuous. Some of these sandstones exhibit high permeabilities and appear to be excellent aquifers.

In the Blessing area, shale tectonics combined with regional growth faulting to produce sinuous fault patterns and fault blocks of varying size in the lower Frio Formation. The primary fault block, nearly 36 mi^2 in extent, is elongate parallel to strike and is about twice as long as it is wide. Optimum sandstone distribution roughly parallels depositional and structural strike and occurs along the central axis of the fault block. These strike-oriented sandstone bodies were probably deposited in barrier-strandplain environments.

In contrast to the Pleasant Bayou and Blessing areas, the structural evolution of the Cuero area did not involve salt mobilization or shale diapirism. Instead, relatively straight and closely spaced growth faults having minimal displacement and minor rollover are typical in the lower Wilcox Group. The resulting fault blocks are narrow and highly elongate. The fault block of interest covers nearly 10 mi^2 and is about 10 times longer than it is wide. Optimum sandstone distribution in the primary fault block is strongly dip aligned. These relatively narrow sandstone bodies exhibit blocky SS patterns and most likely are distributary channel fills. Although the channels have good reservoir

properties, they have substantially smaller areas and volumes than Frio reservoirs.

Features that are similar to the three areas include (1) progradation and deposition near the contemporaneous shelf edge, and (2) structural and stratigraphic factors that control the distribution of geopressure. In these examples, geopressured sandstones are isolated on the updip side of a fault block by downfaulting against shelf-slope shales, and on the downdip side by upfaulting against transgressive marine shales. Moreover, they are isolated above and below by thick sequences of marine shale or interbedded sandstone and shale.

TITLE: ***Design and Operation of a Geopressured-Geothermal Hybrid Cycle Power Plant***
SUBTITLE: ***Final Report Volume I and II February 1991***

AUTHORS: Campbell, Richard G. and Mai M. Hatter
PUBLISHER: The Ben Holt Co.
PAGINATION: 180--Vol. I; 169--Vol. II
PUBLICATION DATE: February 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Hybrid cycle, Equipment design and selection, Test runs, and Component performance

SCOPE:

This report demonstrates the hybrid cycle concept for electricity generation and describes the data that was obtained regarding operation over time of a power plant using a geopressured resource. Electricity was produced from a gas engine burning methane and from a binary cycle operating on heat from engine exhaust and from geothermal brine.

TITLE: ***Development of a Physicochemical Model For Geopressured Brine Reinjection***
SUBTITLE: ***Final Report***

AUTHORS: Alexander, J. H., S. K. Garg, J. W. Pritchett, and J. H. Weare
PUBLISHER: Systems, Science and Software
PAGINATION: 225
PUBLICATION DATE: December 1981
SPONSOR: U.S. Geological Survey
REPORT OR CONTRACT #: not given

DESCRIPTORS: Chemistry, Fluid-flow model, and Physical properties

AUTHOR'S ABSTRACT:

If geothermal fluids are re-injected into the ground after passing through a power plant, chemical reactions may occur between the reinjected brine and the disposal aquifer. If theses chemical reactions have the net effect of creating solid precipitates within the pore spaces, the permeability of the formation will decrease and reinjection will become progressively more difficult. A computer program has been development to examine problems of this kind. In this program, an elaborate fluid/solid chemical reaction model (including aqueous-phase equilibrium, precipitation, dissolution, an ion-exchange effects) has been couple with a radial-flow time-dependent description of the mass an heat transfer within the aquifer during reinjection.

TITLE: ***Drilling and Completion of Pleasant Bayou No. 1 Pleasant Bayou No. 2 and Evaluation of Preliminary Tests***

AUTHORS: Rodgers, John A.
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 219
PUBLICATION DATE: November 1980
SPONSOR: Fenix & Scisson, Inc.
REPORT OR CONTRACT#: SC-PB-80-374
DESCRIPTORS: Regional geology, Petrophysical analysis, Wellhead design, Injection well, Production test, and Production equipment

AUTHOR'S SCOPE:

The Pleasant Bayou prospect, located in Brazoria County, Texas, was drilled as a geothermal-geopressured well under a contract between General Crude Oil Co. and the U.S. Department of Energy. A review of the local geological data confirmed that zones with abnormal pressures and temperatures should be found below a depth of 14,300 ft.

Pleasant Bayou No. 1 was spudded July 1, 1978, and drilled to a depth of 15,676 ft, where a core barrel became stuck while preparing to cut core no. 10. After fishing for 56 days, the operator temporarily abandoned the hole. A workover rig was later used to convert the Pleasant Bayou No. 1 to a disposal well.

The drilling rig was moved to the offset location, Pleasant Bayou No. 2 and started drilling on Jan. 25, 1979. This hole was drilled to a total depth of 16,500 ft and completed as a geopressured-geothermal well on July 11, 1979.

Between Nov. 15, 1979, and Jan. 6, 1980, preliminary production tests were made through temporary separation equipment. The permanent test equipment was installed and the 30-day production test began on September 16, 1980.

TITLE: ***IGT Technical Report***
SUBTITLE: ***"Do We Know Whether the Pleasant Bayou #2 is Saturated with Methane?" Unconventional Natural Gas***

AUTHORS: Randolph, Philip and Evelyn M. Rockar
PUBLISHER: Institute of Gas Technology
PAGINATION: 18
PUBLICATION DATE: May 1981
SPONSOR: Gas Research Institute and DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Methane solubility and Brine

SCOPE:

This reports brings together from several DOE and GRI funded programs information and interpretation of data to update the understanding of the degree of saturation of the Pleasant Bayou aquifer.

TITLE: ***DOE Geothermal Program Review VI***
SUBTITLE: ***Abstracts " Beyond Goals and Objectives"***
AUTHORS: Prestwich, Susan--**CHAIRPERSON**
PUBLISHER: not given
CONFERENCE TITLE: DOE Geothermal Program Review VI
PAGINATION: not given
PUBLICATION DATE: April 1988
SPONSOR: DOE
REPORT OR CONTRACT#: not given

SCOPE:

A collection of abstracts from the DOE Geothermal Program Review VI in April 1988.

TITLE: ***Design, Drilling and Completion Plans For The Lafourche Crossing Geopressure Test Well and Disposal Wells***
SUBTITLE: ***Appendix A***

AUTHORS: not given
PUBLISHER: The State of Louisiana Department of Natural Resources
PAGINATION: 160
PUBLICATION DATE: July 1979
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: Design criteria and Contingency cost

SCOPE:

This report describes the design, drilling and completion plans for the Lafourche Crossing Geopressure test and disposal wells. Also included in this report are the design criteria and the cost of this project.

TITLE: ***DOE/GRI Industry Meeting March 4-5, 1986, Review of Geopressured-Geothermal and Co-Production Research***

AUTHORS: Coffer, H. F. and R.W. Howell
PUBLISHER: Idaho National Engineering Laboratory and EG&G Idaho
PAGINATION: 450
PUBLICATION DATE: January 1987
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: N/A

SCOPE:

Minutes of the DOE/GRI Industry Meeting. Including a transcript of the questions and answers following each presentation and copies of slides and/or summaries prepared by each speaker.

TITLE: ***Design, Drilling and Completion Plans For The Lafourche Crossing Geopressure Test Well and Disposal Wells***
SUBTITLE: ***Appendix A***

AUTHORS: not given
PUBLISHER: The State of Louisiana Department of Natural Resources

PAGINATION: 160
PUBLICATION DATE: July 1979
SPONSOR: not given
REPORT OR CONTRACT #: not given
DESCRIPTORS: Design criteria and Contingency cost

SCOPE:

This report describes the design, drilling and completion plans for the Lafourche Crossing Geopressure test and disposal wells. Also included in this report is the design criteria and the cost of this project.

TITLE: ***Economic Review of the Geopressured-Geothermal Resource with Recommendations***

AUTHORS: Plum, Martin M., J. Negus-de Wys, David D. Faulder, and Ben C. Lunis
PUBLISHER: EG&E Idaho and Idaho National Engineering Laboratory
PAGINATION: 37
PUBLICATION DATE: November 1989
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Reservoir life, Economic methodology, and Economic assumptions

AUTHOR'S ABSTRACT:

This report presents the results of an economic study conducted by the INEL under DOE Contract No. DAC07-76ID0 1570 to evaluate the breakeven price to market energy from a geopressured-geothermal resource. A breakeven price is a minimum, per unit charge required for the developer to recover all direct and indirect costs and a rate of return sufficient to compensate the developer for depreciation the time value of money, and the risk of failure. The DOE Geopressured-Geothermal Research Program and the DOE well testing and operations at three locations in the Gulf Coast region provide the bulk of resource and economic characteristics for this study. A menu-driven model was developed in LOTUS-123 to calculate the breakeven price to market gas and electricity from a geopressured-geothermal resource. This model was developed using the present value methodology and conservative assumptions.

Assuming present well constraints and current off-the-shelf conversion technology, the breakeven price for electricity is about $0.26/kWh using only the thermal energy from a Hulin-type resource. Assuming identical resource and technology constraints, the breakeven price is reduced to about $0.15/kWh when using all available energy forms (methane, hydraulic, and thermal). Assuming the use of available advanced technologies, the breakeven price is reduced to about $0.10/kWh.

Assuming the higher quality resource (with higher temperature and gas content) in the South

Texas cases, the breakeven cost is about $0.095/kWh. Using advanced technology, this cost is further reduced to about $0.05/kWh. Both costs are within program goals.

The results of this study suggest that the future direction of the Geopressured-Geothermal Program emphasize (a) selection of higher quality resource, (b) advanced energy conversion technology, and (c) total energy utilization.

TITLE: ***Environment Assessment Geothermal Energy Geopressure Subprogram***
SUBTITLE: ***GCO-DOE Pleasant Bayou No.1 Brazoria County Texas***

AUTHOR: not given
PUBLISHER: U.S. Department of Energy
PAGINATION: 130
PUBLICATION DATE: March 1978
SPONSOR: DOE
REPORT OR CONTRACT#: DOE/EA-0013
DESCRIPTORS: Proposed action, Existing environment, and Environmental impacts

SCOPE:

This Environmental Assessment (EA) has been prepared to assess the environmental implications of the Department of Energy's proposal to drill, complete, and test one geopressure well located in Brazoria County on a 2 hectares (five acre) test site 64 km (40 mi) south of Houston, Abstract 107, Perry &-Austin Survey, Brazoria County, TX (Fig. 1-1). The test well is herein referred to as GCO-DOE Pleasant Bayou No. 1. A maximum of four disposal wells will be located within .8 km (½ mi) of the proposed well. The Department of Energy (DOE) and The University of Texas Center for Energy Studies propose to operate the test facility for three years to evaluate the geopressure potential of the subsurface. Tests to be conducted include flow rates, fluid composition, temperature, gas content, geologic characteristics, and the land subsidence potential for subsequent production.

This EA activity falls under the broad subprogrammatic Environmental Impact Assessment, Geopressure Subprogram, EIA/GE/77-3, July 1977, Division of Geothermal Energy, Energy Research and Development Administration; the activity associated with the Frio Formation of Texas and Louisiana.

TITLE: ***Environmental Assessment Geothermal Energy Geopressure Subprogram***
SUBTITLE: ***DOE Lafourche Crossing No.1 Terrebonne Parish and Lafourche Parish,***

Louisiana

AUTHORS: not given
PUBLISHER: U.S. DOE
PAGINATION: 219
PUBLICATION DATE: October 1978
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Proposed action, Existing environment, Impacts, and Environmental effects

SCOPE:

This Environmental Assessment (EA) has been prepared to assess the environmental implications of the Department of Energy's (DOE's) proposal to drill, complete, and test one geopressure well located in Terrebonne and Lafourche Parishes on a 2 ha (5 ac) test site, 5 km (3 mi) south of Thibodaux, LA. (Fig. 1-1). The test well is herein referred to as DOE Lafourche Crossing No. 1. A maximum of four disposal wells will be located within .8 km (l/2 mi) of the proposed well. The Department of Energy (DOE) and the State of Louisiana through the State University system proposes to operate the test facility for three years to evaluate the geopressure potential of the subsurface. Tests to be conducted include flow rates, fluid composition, temperature, gas content, geological characteristics, and the land subsidence potential for subsequent production. The exact location of the proposed action has not yet been determined. This EA evaluates the impacts of the proposed action on the Prime Prospect Area and will be applicable regardless of the selection process.

This EA activity falls under the broad subprogrammatic Environmental Impact Assessment, Geopressure Subprogram, EIA/GE/77-3, July 1977, Division of Geothermal Energy, Energy Research and Development Administration.

TITLE: ***Environmental Assessment Dow Parcperdue Geopressure Project***
SUBTITLE: ***Vermilion Parish, Louisiana***

AUTHORS: not given
PUBLISHER: U.S. Department of Energy
PAGINATION: 91
PUBLICATION DATE: March 1980
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Affected environment, Environmental consequences, Environmental monitoring program, and Archaeological and historic preservation

SCOPE:

This Environmental Assessment has been prepared to evaluate the environmental consequences of the drilling, completion, and testing of geopressure well in Vermilion Parish, Louisiana.

TITLE: ***Environmental Research Plan for Gas Supply Technologies***
SUBTITLE: ***Volume I Executive Summary Final Report May 29, 1981***

AUTHORS: Tipton, L. M. and P.D. Junkin
PUBLISHER: Gas Research Institute
PAGINATION: 93
PUBLICATION DATE: May 1981
SPONSOR: Gas Research Institute
REPORT OR CONTRACT#: 5080-351-0316
DESCRIPTORS: Environmental laws and regulations, Unconventional natural gas, Coal, and Biomas

AUTHOR'S ABSTRACT:

The study was initiated with a review and analysis of Federal environmental regulations affecting gas supply technologies. An updated regulatory analysis appears in the final report. Next, the technological and environmental state of the art of each gas supply technology was analyzed with the help of a series of consultants recommended by GRI, each of whom is considered an expert in a given gas supply technology area. Based on regulatory requirements, technology status, and current environmental knowledge, the environmental issues associated with each technology area were identified. Environmental research being performed by government, industry, and educational institutions was identified by computerized literature search and reviewed for applicability. Finally, recommended research activities for GRI funding were developed and a suitable prioritization methodology was devised.

TITLE: ***Environmental Sampling and Analysis Plan for the Geopressured-Geothermal Program***

AUTHORS: Lugar, Robert M.
PUBLISHER: EG&G Idaho, Inc.
PAGINATION: 114
PUBLICATION DATE: September 1989
SPONSOR: DOE
REPORT OR CONTRACT #: not given

DESCRIPTORS: Sampling and analytical design, Sample and document, and Quality assurance/quality control

SCOPE:

The purpose of this sampling and analysis plan was to ensure the groundwater, surface water, and brine monitoring data collected for the Geopressure-Geothermal Program is of known quality and consistently meets the stated program objectives. This plan was designed to be a useful document for field sampling personnel, the analytical laboratory, key program decision makers, and regulatory agencies.

TITLE: ***Evaluation of Environmental Mitigation and Monitoring Commitments at Four Geopressure Design Wells***

AUTHORS: Reed, A.W., D.B. Hunsaker, R.D. Roop, and J.W. Webb
PUBLISHER: Oak Ridge National Laboratory
PAGINATION: 54
PUBLICATION DATE: February 1983
SPONSOR: DOE
REPORT OR CONTRACT#: W-7405-ENG-26
DESCRIPTORS: Monitoring activities and Decommissioning

AUTHOR'S SCOPE:

This report evaluates the implementation of environmental mitigation and monitoring commitments made by the U.S. Department of Energy (DOE) In National Environmental Policy Act documents Environmental Assessments (EAs) prepared for our Geopressure design well projects, one in Texas and three in Louisiana. The evaluation is based on visits to the project Sites conducted by Oak Ridge National Laboratory (ORNL) staff in August 1982 and on 8 review of monitoring and project activity reports provided by DOE subcontractors.

TITLE: ***Evaluation of Five Potential Geopressure Geothermal Test Sites in Southern LA***

AUTHORS: Bernard, W.J.
PUBLISHER: Petroleum Engineering Department Louisiana State University
PAGINATION: 121
PUBLICATION DATE: June 1979

SPONSOR: DOE
REPORT OR CONTRACT#: EY-76-S-05-4889
DESCRIPTORS: Geology, Stratigraphy, Temperature, Pressure, Salinity, Porosity, Permeability, Dissolved gas, and Salt water disposal

AUTHOR'S ABSTRACT:

Five geopressured-geothermal prospects in southern Louisiana were studied in detail to assess their potential use as test sites for the production of geopressure-geothermal energy. Each of the five sites contains substantial quantities of producible energy and appears to be an attractive test site.

TITLE: ***Evaluation of Potential Geothermal Well-Head Flow Sampling and Calorimeter Methods***

AUTHORS: Cliff, W.C., W. J. Apley, and J. M. Creer
PUBLISHERS: Earth Sciences Division Lawrence Berkeley Laboratories, University of California at Berkeley
PAGINATION: 25
PUBLISHER AND DATE: June 1979
SPONSOR: Division of Geothermal Energy of DOE
REPORT OR CONTRACT#: W-7405-ENG-48
DESCRIPTORS: Calorimeter systems and Enthalpy measurements

SCOPE:

The objective of this study was to evaluate, select, and conceptually design calorimeter systems that could potentially permit economical, reliable and accurate measurements of the enthalpy of multiphase fluids at geothermal well heads. This study identified seven candidate calorimeter methods to obtain well-head enthalpy measurements.

TITLE: ***Final Report Pauline Kraft Well No.1 Nueces County, Texas Completion and Testing***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHOR: not given
PUBLISHER: Eaton Industries of Houston, Inc. Eaton Operating Company, Inc
PAGINATION: 130
PUBLICATION DATE: 1981

SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Geology, Petrophysics, Re-Entry and completion Operations- Test Well, Drilling and completion operations- disposal well, Surface testing facilities, Testing operations, and Abandonment of wells and location

AUTHOR'S SCOPE:

Eaton Operating Company, Inc. (Eaton) operates the Wells of Opportunity program under contract to the Department of Energy, Division of Geothermal Energy, to evaluate potential alternative energy sources in geopressured-geothermal (GEO) aquifers along the Texas and Louisiana Gulf Coast. This report covers the test of the Pauline Kraft Well No. 1, about 6 miles south of Corpus Christi, Texas.

The Pauline Kraft Well No. 1 was originally drilled to a depth of 13,001 feet by the Coastal States Gas Corporation in 1971, and was abandoned as a dry hole. The well was re-entered by Ross-Pope Drilling Equipment Company in an effort to obtain a source of GEO energy for a proposed gasohol manufacturing plant. Eaton assumed temporary control of the site on December 19, 1980, to test the well for the Wells of Opportunity program.

The well was tested through a 5-inch by 2-3/8 inch annulus. The geological section tested was the Frio-Anderson sand of Mid-Oligocene age. The interval tested was from 12,750 to 12,860 feet. A saltwater disposal well was drilled on the site and completed in a Micocene sand section. The disposal interval was perforated from 4710 to 4770 feet and from 4500 to 4542 feet.

The test well failed to produce water at substantial rates. Initial production was 34 BWPD. A large acid stimulation treatment increased productivity to 132 BWPD, which was still far from an acceptable rate. During the acid treatment, a failure of the 5-inch production casing occurred.

The poor production rates are attributed to a reservoir with very low permeability and possible formation damage. The casing failure is related to increased tensile strain resulting from cooling of the casing by acid and from the high surface injection pressure. The location of the casing failure is not known at this time, but it is not at the surface. Failure as a result of a defect in a "crossover" joint at 723 feet is suspected.

Further remedial work and stimulation were not considered worthwhile, and testing was terminated on March 22,1981. The location was returned to Ross-Pope Drilling Equipment Company on April 15,1981. That company plans to further test the well.

TITLE: ***Annual Report Volume I***
SUBTITLE: ***Environmental Baseline Monitoring in the Area of General Crude Oil - Department of Energy Pleasant Bayou Number 2-A Geopressured Geothermal Test Well***

AUTHORS: Gustavson, Thomas, Rory C. Howard, and Douglas McGookey
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 61

PUBLICATION DATE: 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-77ET28504
DESCRIPTORS: Air quality, Water quality, and Microseismic monitoring

SCOPE:

A program to monitor baseline air and water quality, subsidence, microseismic activity, and noise in the vicinity of Brazoria County geopressured geothermal test wells, Pleasant Bayou #1 and #2, has been underway since March 1978. The following report continues the description of baseline air and water quality of the test well site, includes an inventory of microseismic activity during 1979 with interpretations of the origin of the events, and discusses the installation and monitoring of a liquid tilt meter at the test well site. In addition, a brief description of flooding at the test site is presented.

TITLE: ***Annual Report Volume II***
SUBTITLE: ***Environmental Baseline Monitoring in the Area of General Crude Oil - Department of Energy Pleasant Bayou Number 2-A Geopressured Geothermal Test Well***

AUTHORS: Gustavson, Thomas C., Rory C. Howard, and Douglas McGookey
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: 245
PUBLICATION DATE: 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-777ET28504
DESCRIPTORS: Air quality monitoring and Methane bag sampling

SCOPE:

Radian Corporation is under contract to the University of Texas, Bureau of Economic Geology, to provide ambient air quality monitoring at one site near Chocolate Bayou, Texas. This report describes site measurements and records of concentrations for sulfur dioxide, hydrogen sulfide, methane, and particulates. A bag sample is collected bi-weekly and returned to Radian's Austin facilities and analyzed for methane.

TITLE: ***Economic Review of the Geopressured-Geothermal Resource with Recommendations***

AUTHORS: Plum, Martin, J. Negus-de Wys, David D. Faulder, and Ben C. Lunis
PUBLISHER: Idaho National Engineering Laboratory
PAGINATION: 33
PUBLICATION DATE: November 1989
SPONSOR: DOE Idaho Operations Office
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Resource assumptions, Economic methodology and Assumptions

SCOPE:

This report presents the results of an economic study conducted by the INEL under DOE Contract No. DE-AC07-76ID01570 to evaluate the breakeven price to market energy from a geopressured-geothermal resource. A breakeven price is a minimum, per unit charge required for the developer for depreciation, the time value of money, and the risk of failure. The DOE Geopressured-Geothermal Research Program and the DOE well resource and economic characteristics for this study. A menu-driven model was developed LOTUS-123 to calculate the breakeven price to market gas and electricity from a geopressured-geothermal resource. This model was developed using the present value methodology and conservative assumptions.

Assuming present well constraints and current off-the-shelf conversion technology, the breakeven price for electricity is about $0.26/kWh when using all available energy forms (methane, hydraulic, and thermal). Assuming the use of available advanced technologies, the breakeven price is reduced to about $0.10/kWh.

Assuming the higher quality resource (with higher temperature and gas content) in the South Texas cases, the breakeven cost is about $0.05/KWh. Both costs are within program goals.

The results of this study suggest that the future direction of the Geopressured-Geothermal Program emphasize (a) selection quality resource, (b) advanced energy conversion technology, and (c) total energy utilization.

TITLE: ***Failure Analysis Report***
SUBTITLE: ***Production Tube Components From Three DOE Geopressured-Geothermal Wells on the Texas-Louisiana Gulf Coast***

AUTHORS: Ellis, Peter F. II and Dennis M. Anliber
PUBLISHER: Radian Corporation
PAGINATION: 61
PUBLICATION DATE: December 1983
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC03-81SF11503
DESCRIPTORS: Geofluid, Tensile test, Corrosion, and Failed couplings

SCOPE:

This report presents the results of materials performance evaluations conducted on production

tube assembly components from three DOE geopressured-geothermal wells on the Texas-Louisiana Gulf Coast. Field and laboratory investigations were performed to determine the cause-of-failure and/or condition of a fractured production tube coupling and corroded pins from the Pleasant Bayou No. 2 well near Alvin, Texas, sealing tool components from the Gladys McCall No. 1 well near Lake Charles, Louisiana and production tubing from the Amoco Fee No. 1 well, also near Lake Charles, Louisiana.

TITLE: ***Feasibility Study: Application of the Geopressured-Geothermal Resource to Pyrolytic Conversion or Decomposition/Detoxification Processes***

AUTHORS: Propp, Alan W., Alan E. Grey, Jane Negus-de Wys, Martin M. Plum, and Daryl R. Haefner
PUBLISHER: Idaho National Engineering Laboratory and EG&G Idaho
PAGINATION: 87
PUBLICATION DATE: September 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Pyrolytic conversion process, Decomposition/detoxification process, and Economic evaluation

AUTHOR'S ABSTRACT:

This study presents a preliminary evaluation of the technical and economic feasibility of selected conceptual processes for pyrolytic conversion of organic feedstocks or the decomposition/detoxification of hazardous wastes by coupling the process to the geopressured-geothermal resource. The report presents a detailed discussion of the resource and of each process selected for evaluation including the technical evaluation of each. A separate section presents the economic methodology used and the evaluation of the-technically viable process. A final section presents conclusions and recommendations. Three separate processes were selected for evaluation. These are pyrolytic conversion of biomass to petroleum like fluids, wet air oxidation (WAO) at subcritical conditions for destruction of hazardous waste, and supercritical water oxidation (SCWO) also for the destruction of hazardous waste. The scientific feasibility of all three processes has been previously established by various bench-scale and pilot-scale studies.

For a variety of reasons detailed in the report the SCWO process is the only one deemed to be technically feasible, although the effects of the high solids content of the geothermal brine need further study. This technology shows tremendous promise for contributing to solving the nation's energy and hazardous waste problems. However, the current economic analysis suggests that it is uneconomical at this time, primarily because of uncertainties in the technical, capital cost, and operating parameters necessitating conservative economics assumptions in the analysis. Further effort is refining requirements for design and operation of this process is recommended.

TITLE: ***Field Evaluation of Sampling Methods for pressurized Geothermal Liquids, Gases, and Suspended Solids***

AUTHORS: Shannon, D. W., M. W. Cole, D.D. DeMonia,, J .R. Divine ,G.A. Jensen, C.H. Kindle, O. H. Koski., R. P. Smith, and E.M. Woodruff
PUBLISHER: Pacific Northwest Laboratory operated by Battelle Memorial Institute
PAGINATION: 250
PUBLICATION DATE: January 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC06-76RLO 1830
DESCRIPTORS: Probe/double-cooing sampling method, pH, CO2, H2S, Silica, Stainless steel cylinders, Suspended solids, Gas composition, and Two-phase systems

AUTHOR'S ABSTRACT:

Many different sampling methods were tested and compared for collecting samples for measurement of brine chemistry, gases, and suspended solids from pressurized geothermal systems. The tests were conducted on the 6-2 wellhead and a test loop at the Department of Energy's Geothermal Test Facility at East Mesa, California. The recommended methods for single-phase liquid or single-phase steam (with gases) are presented, together with detailed procedures. The results of testing methods for sampling two phase liquid-steam systems showed significant errors can result. It was recommended that two-phase flowing wells be directed to a full flow separator and the single-phase liquid and single-phase steam sampled separately using the recommended methods.

TITLE: ***Fifty Years of Development of thought on the Origin and Evolution of Subsurface Sedimentary Brines***

AUTHORS: Hanor, Jeffrey
PUBLISHER: Louisiana State University
PAGINATION: 13
PUBLICATION DATE: 1983
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Chemical and physical properties of brines, Diagenesis, and Thermodynamic control

SCOPE:

Approximately 20% by volume of the sedimentary portion of the earth's crust is pore water, most of which is hot, salty, and under high pressure. The presence of these complex aqueous fluids has played a critical role in the physical, geochemical, and economic evolution of the crust. The origin of those waters has been debated for decades. Particularly perplexing problems include: 1) why the waters are as saline as they are, especially in basins apparently devoid of evaporites, and 2) why the relative proportions of major dissolved species are unlike those of any known surface marine water or brine.

Fifty years ago, deep brines were thought to have originated through removal of H_2O molecules by subsurface evaporation into a methane gas phase. Today, the high salinities and chloride concentrations of most subsurface waters are thought to have originated by one or more of the following mechanisms:
1) membrane filtration, in which H_20 molecules are preferentially forced through a shale membrane and dissolved ions are concentrated in a residual brine; 2) infiltration and burial of brines produced by the subaerial evaporation of surface waters; and 3) subsurface dissolution of halite.

While membrane-filtration continues to have its adherents, no unambiguous, large-scale example has yet been identified in the field. Whatever the source of high TDS and chloride values, the drive toward thermo-dynamic equilibrium during progressive burial has played a key role in modifying brine compositions, as attested to by the successful application of brine geothermometers. Maintenance of equilibrium between brine and quartz, feldspars, sheet silicates, and carbonates appear to be particularly important factors which influence brine compositions. Exchange between brine and host sediment profoundly alters the isotopic composition of these waters.

There is at the present time considerable interest in the role of sedimentary brines as possible ore-forming fluids and in the economic potential of geopressured brines as sources of dissolved methane, thermal energy, and mechanical energy. Further advances in our understanding of the origin of these fluids will come as studies of basin evolution integrate all aspects of depositional history, thermal and structural evolution, hydrology, and subsurface phase equilibrium and mass transfer.

TITLE: ***Final Report Crown Zellerbach Well No.2 Livingston Parish, Louisiana Volume I Completion and Testing***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***
TITLE: ***Final Report Crown Zellerbach Well No. 2 Livingston Parish, Louisiana Volume II Well Test Data***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: Volume I: 272 Volume II: 329

PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET27081
DESCRIPTORS: Geology, Petrophysics, Re-entry and completion, Disposal well, Surface testing facilities, Pre-test operations, Test sequence, Test results and analysis, Solids production, scaling and corrosion, and Plug and abandonment

SCOPE:

The Crown Zellerbach Well No. 2, approximately 23 miles east of Baton Rouge, Louisiana, is the eighth successful test of a geopressured-geothermal aquifer under the DOE Wells of Opportunity program. Eaton Operating Company, Inc. assumed control of the site on February 20, 1981 after Martin Exploration Company had abandoned the well as a dry hole at a depth of 17,000 feet.

The well was tested through the annulus between 7-inch casing and 2-3/8 inch tubing. Two intervals of the Tuscaloosa Trend were tested. The lower zone was perforated from 16,720 to 16,750 feet and was tested separately. The upper zone, from 16,462 to 16,490 feet, was later perforated and tested together with the lower zone. Produced water was injected into the Crown Zellerbach Well No. 1, which was also a dry hole acquired from Martin Exploration Company and converted into a disposal well. The disposal well was perforated in a Miocene sand from 4833 to 4908 feet.

Two flow tests and one reservoir pressure buildup test were conducted on the lower zone during a 13-day period. A total of 12,489 barrels of water was produced. The highest flow rate achieved was about 3887 BWPD.

One flow test followed by a buildup period was conducted on the combined upper and lower zones during a 3-day period. A total of 4739 barrels of water was produced. The highest flow rate achieved was about 3000 BWPD.

The gas/water ratio measured during testing was about 32.0 SCF/BBL for the lower zone. The extrapolated laboratory data indicates that the solubility of the gas is 55.7 SCF/BBL. It appears that the reservoir brine is considerably undersaturated. Chemical and physical differences between the produced fluids of he lower zone and the combined zones were slight.

The methane content of the flare line gas averaged 71.0 mole percent. The methane content is the lowest measured to date when compared to previous WOO tests. The CO_2 content averaged 23.5 mole percent, which is the highest to date relative to previous WOO tests. Liquid hydrocarbon production is estimated to have been in the range of 2 to 5 barrels of oil per 10,000 barrels of water and was much higher relative to brine production than on any prior WOO test with the exception of the G.M. Koelemay Well No. 1.

The original bottom-hole pressure of the lower zone was 10,114 psia, with a corresponding static surface pressure of 2900 psia. The reservoir temperature was 330°F. The highest surface temperature observed during flow was 201°F. The lower zone appeared to be a relatively tight sand with increasing sand thickness further from the wellbore. The permeability to reservoir fluids is approximately 14.1 millidarcies. Surface pressure drawdown data on the combined upper and lower zones indicates a surprisingly higher productivity of 2218 millidarcy-feet as compared to a productivity of 495 millidarcy-feet for the bottom zone alone. This conclusion cannot be supported by other physical or chemical data. In either case, the reservoirs were not capable of the high sustained production rates needed for commercial considerations. Crown Zellerbach Company carefully studied the commercial feasibility of using the well to produce energy for a wood-drying

facility and decided against the project.

The total dissolved solids in the produced brine averaged 31,700 mg/l for the lower zone. Scaling and corrosion of the surface equipment were so light that no conclusion can be made concerning long-term chemical treatment requirements.

The lower zone produced solids at the rate of 20 to 190 pounds per 1000 barrels. The produced solids were predominately sand which accumulated in the separator. When the upper and lower zones were tested, solids production was very low. The reason for this is not clear.

Concentration of boron averaged 48 milligrams per liter. This concentration is extremely toxic to plant life. Long-term surface disposal of untreated brine would be precluded because of the boron content. The mercury content was less than 0.2 micrograms per liter and would probably not be a hazard to the environment during long-term surface disposal.

TITLE: ***Final Report Geothermal Well Site Restoration and Plug and Abandonment of Wells***
SUBTITLE: ***DOE Pleasant Bayou Test Site Brazoria County, Texas***

AUTHORS: Rinehart, Ben N. and Ben H. Siegel
PUBLISHER: EG&G
PAGINATION: 129
PUBLICATION DATE: March 1994
SPONSOR: DOE
REPORT OR CONTRACT#: C93-160681
DESCRIPTORS: Restoration plan and schedule, Plugging of water wells, Soil and water sampling analysis, and Norm survey

SCOPE:

For a variety of reasons, thousands of oil and gas wells have been abandoned in the Gulf Coast Region of the United States. Many of these wells penetrated geopressured zones whose resource potential for power generation was undervalued or ignored. The U.S. Department of Energy (DOE) Geopressured-Geothermal Research Program was chartered to improve geothermal technology to the point where electricity could be commercially produced from a substantial number of geopressured resource sites. This research program focused on relatively narrow technical issues that are unique to geopressured resources such as the ability to predict reservoir production capacity based on preliminary flow tests. Three well sites were selected for the research program. These are the Willis Hulin and Gladys McCall sites in Louisiana, and the Pleasant Bayou site in Texas. The final phase of this research project consists of plug and abandonment (P&A) of the wells and site restoration.

TITLE: ***Final Report***

SUBTITLE: ***Mechanical and Geological Characteristics of Rock Samples From Sweezy No. 1 well At Parcperdue Geopressured/Geothermal Site***
AUTHORS: Sinha, K.P., M.T. Holland, T.F. Borschel, and J.F. Schatz
PUBLISHER: Terra Tek, Inc.
PAGINATION: 126
PUBLICATION DATE: November 1981
SPONSOR: Dow Chemical Company Oil and Gas Division
REPORT OR CONTRACT #: not given
DESCRIPTORS: Core testing and Geology

AUTHOR'S ABSTRACT:

The mechanical and transport properties and characteristics of rock samples obtained from DOW-DOE L. R. SWEEZY NO. 1 TEST WELL at the Parcperdue Geopressure/Geothermal Site have been investigated in the laboratory. Elastic moduli, compressibility, uniaxial compaction coefficient, strength, creep parameters, permeability, acoustic velocities (all at reservoir conditions) and changes in these quantities induced by simulated reservoir production have been obtained from tests on several sandstone and shale samples from different depths. Most important results were that the compaction coefficients were approximately an order of magnitude lower than those generally accepted for the reservoir sand in the Gulf Coast area and that the creep behavior was significant.

Geologic characterization included lithological description, SEM micrographs and mercury intrusion tests to obtain pore distributions. Petrographic analysis shows that approximately half of the total sand interval had excellent reservoir potential and that most of the effective porosity in the Cibb Jeff Sand was formed by secondary porosity development.

TITLE: ***Final Report on Decommissioning of Wells, Boreholes and Tiltmeter Sites Gulf Coast Interior Salt Domes of Louisiana***

AUTHOR: Stone & Webster Engineering Corporation
PUBLISHER: Stone & Webster Engineering Corporation
PAGINATION: 324
PUBLICATION DATE: July 1989
SPONSOR: DOE Salt Repository Project Office
REPORT OR CONTRACT #: not given
DESCRIPTORS: Field activities and Documentation

SCOPE:

In 1988, the Department of Energy authorized SWEC to decommission test well and tiltmeter sites at Vacherie and Rayburns Domes. During May and June, SWEC prepared required documents (Activity Plans, Project Procedures, and Scopes of Work), searched records for needed data, and completed the initial phases of site reconnaissance. During July and August, SWEC awarded contracts for site work, transferred and acquired necessary leases, obtained state permits, repaired access roads and site pads, and completed downhole reconnaissance activities. SWEC subcontractors decommissioned four of the five tiltmeter sites and surveyed the locations of the V-4, V-6, V-7 wells, the LSU-R1A well, and the five tiltmeter sites.

Well plugging began on September 1 and required, with the exception of the V-5 well, 11 weeks to complete. Plugging was completed on November 18 and restoration was completed on December 1. Well V-5 was not located until December 14, and scheduling problems prevented its plugging until January 11, 1989.

An extensive effort was made between June and November to locate the 118 shallow borings, which resulted in one tentative location being found. Stone & Webster has concluded from this search and other evidence (Section 3.7) that the shallow borings were sufficiently backfilled to eliminate any possible safety hazard. All field-related close-out activities for the salt dome sites in Louisiana have been completed.

TITLE: ***Final Report on Well Plug and Abandonment Operations and Wellsite Restoration***
SUBTITLE: ***U.S. DOE Geopressured/Geothermal Program Louisiana and Texas Wells***

AUTHORS: not given
PUBLISHER: D-O-R Engineering, Inc.
PAGINATION: 121
PUBLICATION DATE: August 1994
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Norm

SCOPE:

This report documents the operations conducted during the plugging and abandonment of the three producing wells of the U.S. DOE GEOPRESSURED/GEOTHERMAL PROGRAM that were witnessed by D-O-R Engineering personnel. All operations witnessed by D-O-R personnel were in compliance with the respective state regulations and were conducted as per D-O-R's recommendations to the Department of Energy and their prime contractor, EG&G Idaho.

TITLE: ***Final Report Pauline Kraft Well No.1 Nueces County, Texas Completion and Testing***

SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHOR: not given
PUBLISHER: Eaton Industries of Houston, Inc. Eaton Operating Company, Inc
PAGINATION: 130
PUBLICATION DATE: 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Geology, Petrophysics, Re-Entry and completion Operations- Test Well, Drilling and completion operations- disposal well, Surface testing facilities, Testing operations, and Abandonment of wells and location

SCOPE:

Eaton Operating Company, Inc. (Eaton) operates the Wells of Opportunity program under contract to the Department of Energy, Division of Geothermal Energy, to evaluate potential alternative energy sources in geopressured-geothermal (GEO) aquifers along the Texas and Louisiana Gulf Coast. This report covers the test of the Pauline Kraft Well No. 1, about 6 miles south of Corpus Christi, Texas.

The Pauline Kraft Well No. 1 was originally drilled to a depth of 13,001 feet by the Coastal States Gas Corporation in 1971, and was abandoned as a dry hole. The well was re-entered by Ross-Pope Drilling Equipment Company in an effort to obtain a source of GEO energy for a proposed gasohol manufacturing plant. Eaton assumed temporary control of the site on December 19, 1980, to test the well for the Wells of Opportunity program.

The well was tested through a 5-inch by 2-3/8 inch annulus. The geological section tested was the Frio-Anderson sand of Mid-Oligocene age. The interval tested was from 12,750 to 12,860 feet. A saltwater disposal well was drilled on the site and completed in a Micocene sand section. The disposal interval was perforated from 4710 to 4770 feet and from 4500 to 4542 feet.

The test well failed to produce water at substantial rates. Initial production was 34 BWPD. A large acid stimulation treatment increased productivity to 132 BWPD, which was still far from an acceptable rate. During the acid treatment, a failure of the 5-inch production casing occurred.

The poor production rates are attributed to a reservoir with very low permeability and possible formation damage. The casing failure is related to increased tensile strain resulting from cooling of the casing by acid and from the high surface injection pressure. The location of the casing failure is not known at this time, but it is not at the surface. Failure as a result of a defect in a "crossover" joint at 723 feet is suspected.

Further remedial work and stimulation were not considered worthwhile, and testing was terminated on March 22,1981. The location was returned to Ross-Pope Drilling Equipment Company on April 15,1981. That company plans to further test the well.

TITLE: ***Final Report Prairie Canal Well No.1 Calcasieu Parish, Louisiana Volume I Completion and Testing***

SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***
TITLE: ***Final Report Prairie Canal Well No.1 Calcasieu Parish, Louisiana Volume II Well Test Data***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHOR: not given
PUBLISHER: Eaton Industries of Houston, Inc. Eaton Operating Company, Inc.
PAGINATION: Volume I: 326; Volume II: 522
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET27081
DESCRIPTORS: Geology, Petrophysics, Re-entry and completion operations-test well, Drilling and completions operations-disposal well, Test objectives, Surface testing facilities, Test sequence, Test results and analysis, Quantities and properties of produces fluids, Produced gases, Gas/brine ratio, Separator performance, Solids production, Scaling , Corrosion, and Plug and abandonment operations

SCOPE:

The Prairie Canal Company, Inc. Well No. 1, approximately 8 miles south of the city of Lake Charles, Louisiana, is the seventh successful test of a geopressured-geothermal aquifer under the DOE Wells of Opportunity program. Eaton Operating Company, Inc. assumed control of the site on October 20, 1980, when Houston Oil and Minerals Corporation abandoned the well as a dry hole at a depth of 15,636 feet.

The well was tested through the annulus between 5-1/2 inch casing and 2-3/8 inch tubing. The interval tested was from 14,782 to 14,820 feet. The geological section was the Hackberry Sand, a member of the Oligocene Frio formation. Produced water was injected into a disposal well which was perforated in several Miocene Sands from 3070 to 4600 feet. The interval tested was not the primary zone in the well. Original plans were to test a section of the Hackberry sand from 14,976 to 15,024 feet. This primary zone, however, produced a large amount of sand, shale, gravel, and rocks during early flow periods and was abandoned in favor of the secondary zone.

Four pressure drawdown flow tests and three pressure buildup tests were conducted during a 12-day period. A total of 36,505 barrels of water was produced. The highest sustained flow rate was approximately 7100 BWPD.

The gas-to-water ratio, measured during testing, ranged from 41 to 50 SCF/BBL. There is disagreement among the contributors to the report as to the saturation value of the reservoir brine, which may be between 43.3 and 49.7 SCF/BBL.

The methane content of the flare line gas averaged 88.4 mole percent. The CO_2 content averaged 8.4 mole percent. Measured values of H_2S in the gas were between 12 and 24 PPM.

The separator's efficiency was independent of brine residence time, for residence times of two minutes or longer. The efficiency is not necessarily an inherent characteristic of the separator hardware; it is mainly a function of brine temperature, gas composition, produced gas/brine ratio, and separator operating pressure. Thermal energy recovery from brine before the separator would improve the quality of gas recovered at any specific separator pressure. Or conversely, in the

particular case of a gas having the composition observed at the Prairie Canal well, prior cooling of brine may well increase marketable gas from single-stage separation by 2-4 SCF per barrel of brine.

The original bottom-hole pressure was 12,942 psia, with a corresponding static surface pressure of 6440 psia. The reservoir temperature was 294°F. The highest surface temperature observed during flow was 250 ° F. The reservoir appeared to be a thin sand zone, restricted by close-by permeability barriers which reduced the flow area to 40°.The permeability to reservoir fluids is approximately 93 millidarcies. Pressure transient analysis indicated that the reservoir was not capable of the high sustained production rates needed for commercial considerations.

The total dissolved solids in the produced brine averaged 43,400 mg/l. Very light scaling and corrosion of the surface equipment was detected. Calcium carbonate scaling would be the predominate treatment problem for long-term production.

Concentrations of mercury in the produced brine averaged 0.79 micrograms per liter. This value is above the 0.10 micrograms per liter upper limit recommended by the U.S. Environmental Protection Agency for protection of aquatic organisms and for human consumption. Concentrations of boron averaged 55 milligrams per liter. This concentration is extremely toxic to plant life. Long-term surface disposal of the produced brine would be precluded because of the mercury and boron concentrations.

It is estimated that over 2700 pounds of formation sand and silt were produced during testing. This well produced more solids than any previous WOO test well. Long-term production would be impossible without sand control at the perforations.

TITLE: ***Final Report P.R. Girouard Well No.1 Lafayette Parish, Louisiana Volume I Completion and Testing***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***
TITLE: ***Final Report P.R. Girouard Well No.1 Lafayette Parish, Louisiana Volume II Well Test Data***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHOR: not given
PUBLISHER: Eaton Industries of Houston, Inc. Eaton Operating Company, Inc.
PAGINATION: Volume I: 287; Volume II: 238
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET27081
DESCRIPTORS: Geology, Petrophysics, Re-entry and completion, Drilling and completion operations, Test objectives, Surface testing facilities, Pre-test operations, Test results and analysis, and Plug and abandonment operations

SCOPE:

The P. R. Girouard No. 1 Well, located approximately 10 miles southeast of Lafayette, Louisiana, was the fourth successful test of a geopressured-geothermal aquifer under the Wells of Opportunity program. Eaton Operating Company, Inc. assumed control of the site on May 6, 1980, when the operator, Wainoco Oil and Gas Company, abandoned the well as a dry hole at a total depth of 15,700 feet.

The well was tested through 3-1/2 inch tubing set on a packer at 14,570 feet without major problems. The geological section tested was the Oligocene Marginulina Texana No. 1 sand of upper Frio age. The interval tested was from 14,744 to 14,819 feet. Produced water was piped down a disposal well perforated from 2,870 to 3,000 feet in a Miocene saltwater sand.

Four flow tests were conducted for sustained production rates of approximately 4,000 BWPD to approximately 15,000 BWPD. The highest achieved, during a fifth short test, was 18,460 BWPD. The test equipment was capable of handling higher rates.

The gas-to-water ratio was relatively uniform at approximately 40 SCF/bbl. Some 1 to 5 SCF of the 40 SCF/bbl were retained in the brine, depending on separator pressure; as separator pressure increased and residence time decreased more gas was retained in the disposal water. Laboratory recombination studies determined a saturation value of about 44.5 SCF/bbl, indicating that this reservoir brine was possibly undersaturated. The heating value of the gas is 970 BTU/SCF.

The initial reservoir drawdown test of one day duration resulted in sufficient transient pressure flow information to develop the needed reservoir data. The information obtained was supplemented and confirmed by a subsequent buildup test and a second drawdown test. These tests depicted a very restricted permeability closure around the well bore, which limited the drainage of the well. The productive sand interval pinched out very rapidly around the well. The reservoir drawdown configuration was very similar to one depicting a completion in the end of an elongated lenticular sand.

The reservoir tests show that it is doubtful that this well would sustain production rates over 10,000 BWPD for any lengthy period from the sand zone in which it was completed. This limited flow capacity is due to the well's poor location in the reservoir and is not a result of any production deficiencies of the Marginulina Texana sand.

The surface test equipment was not treated with chemical to restrict carbonate scaling, because scaling was relatively light (0.03 grams per square inch per 1000 barrels of water) and was not visually observed until the end o the testing. Treatment would be required, however, if long-term production was desired.

Sand production was minimal. Actual measurements indicated production of a very fine formation sand ranging from 0.5 to 1.7 pounds per 1,000 barrels of water. Sand production appeared to be related to high flow rates which resulted in a local drawdown around the well bore.

TITLE: ***Final Report Saltine Well No.2 Zapata County, Texas Volume I Completion and Testing***

SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

TITLE: ***Final Report Saltine Well No.2 Zapata County, Texas Volume II Well Test Data***
SUBTITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHORS: not given
PUBLISHER: Eaton Industries of Houston, Inc. Eaton Operating Co., Inc.
PAGINATION: Volume 1:261 Volume 2: 274
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET27081
DESCRIPTORS: Geology, Petrophysics, Re-entry and completion operations, Test objections, Pre-test operations, Test sequence, Test results and analysis, and Plug and abandonment

SCOPE:

The Saltine Well No. 2, approximately 35 miles Southeast of the city of Laredo, Texas, was the sixth successful test of a geopressured-geothermal aquifer under the DOE Wells of Opportunity Program. Eaton Operating Company, Inc., assumed control of the site on October 8, 1980, when Riddle Oil Company abandoned the well as a dry hole at a depth of 11,171 feet.

The well was tested through the annulus between 7-inch casing and 2-3/8 inch tubing. The interval tested was from 9745 to 9820 feet. The geological section was the 1st Hinnant Sand, an upper member of the Wilcox Group. Produced water was injected into the Saltine Well No. 1, which was also acquired from Riddle Oil Company and converted to a disposal well. A Miocene salt water sand was perforated from 3005 to 3100 feet for disposal.

One pressure drawdown flow test and one pressure buildup test were conducted during a 10-day period. A total of 9328 barrels of water was produced. The highest sustained flow rate was 1950 BWPD.

The gas-to-water ratio, measured during testing by adding flare line gas and gas remaining in solution in brine after the separator, ranged from 47 to 54 SCF/BBL. Laboratory recombination studies determined a saturation value of 40.9 SCF/BBL, indicating that gas production was in excess of solubility in the brine at reservoir conditions. Two successful bottom-hole fluid samples indicated a gas-to-water content of 38.8 SCF/BBL, supporting the recombination data. The CO_2 content of the gas was high and ranged from 26.4 to 16.4 mole percent. The H_2S content of the gas was substantially higher than for any previous GEO^2 test. Measured values were between 57 and 93 ppm.

The measured original bottomhole pressure was 6627 psia, with a corresponding original static surface pressure of 2443 psia. The reservoir temperature was 300°F. The highest surface temperature observed during testing was 220°F. The single reservoir drawdown test provided sufficient transient pressure flow information to develop the needed reservoir data. The reservoir appeared to be relatively tight, with a permeability to reservoir fluid of 12.5 millidarcies. Two permeability barriers were found within 265 feet of the wellbore, restricting the drainage area to about 111 degrees (as opposed to 365°).

The total dissolved solids in the produced brine averaged 12,800 mg/l. Light corrosion of the surface test equipment was observed. Scaling was very light at 0.0050 grams per square inch per 1000 barrels of water. Preventive treatment would have been necessary, however, for long-term production.

Approximately 488 pounds of fine solids were produced during testing. About 37% of the solids

were drilling mud residue; 34% was formation material; and 29% were products precipitated from the brine.

TITLE: ***FY-92 Annual Progress Report Geopressured-Geothermal Program***

AUTHORS: Negus-de Wys, Jane and Ben Rinehart
PUBLISHER: EG&G Idaho, Inc./INEL
PAGINATION: 68
PUBLICATION DATE: October 1992
SPONSOR: DOE
REPORT OR CONTRACT #: not given
DESCRIPTORS: Objectives and Fiscal year accomplishments

SCOPE:

This report describes the progress and plans for the Geopressured-Geothermal Program. Three geopressured-geothermal wells have provided data through the past fiscal year toward the program goals. At the Pleasant Bayou geopressured-geothermal design well in Texas, flow-testing to ascertain reservoir productive capacity and drive mechanisms was continued. The Gladys McCall geopressured-geothermal design well in Louisiana remained shut in for pressure build up. The Hulin Well in Louisiana continued on standby for long term flow testing in the event that funds were made available for long term flow testing. The site was prepared for testing operations and construction of surface facilities was implemented. With no new program funding all three wells are to be plugged and abandoned and the program shut down in FY-93.

University supporting research in logging, rock mechanics, geology, numerical reservoir modeling, subsidence, microseismicity, water quality, brine chemistry, scaling, and aromatic hydrocarbons continued in FY-92 with final reports in progress in several projects including logging geological projects, rock mechanics, and reservoir simulations. The well operations coupled with the supporting university research are designed to improve the ability to forecast reservoir productive capacity, to verify the reliability of the resource as a long-term energy resource, and to determine the environmental effects of long-term production.

The California Energy Commission completed a 50/50 cost share study and no reports on collocation of oil and geopressured fluids in California.

A 12-page color brochure on the geopressured resource was completed and submitted to DOE. Over 500 copies were sent out to the Industrial Consortium mailing list and 500 to the Geothermal Resource Council (GRC). A 200-page selected literature review on the Geopressured Habitat was completed and submitted to DOE. Over 50 requests have been received for the report before printing.

By these means, the Geopressured-Geothermal Research Program has developed a solid technology base and technology transfer framework that private industry can use to evaluate and utilize the geopressured -geothermal resource.

TITLE: ***Final Report-Testing and Sampling Procedures for Geothermal -Geopressured Wells***

AUTHORS: Boyd, W. E.
PUBLISHER: Center for Energy Studies University of Texas at Austin
PAGINATION: 152
PUBLICATION DATE: not given
SPONSOR: United States Gulf Coast Geopressured Program Special Projects Research and Coordination Assistance
REPORT OR CONTRACT #: E-(40-1)-5243
DESCRIPTORS: Testing and sampling techniques, Electric logs and surveys, Geopressured zones, and Cased hole geopressured test well

SCOPE:

Test wells to tap and sample geothermal-geopressured formations at 15,000-20,000 feet in the Gulf Coast area can be drilled routinely utilizing available equipment and methods. Electrical logs, surveys and fluid samplers can be used to obtain accurate and reliable information as to depths, temperatures, pressures, and fluid content of the geopressured formations before the well is completed. But it will be necessary to set casing and flow the well, at least temporarily, to secure fluid production volume and pressure data to evaluate the producibility of the geopressured resource.

Electric logging and wireline survey methods are fully developed techniques for measuring the parameters needed to assess a geopressured zone before setting casing. Formation subsidence, though it may be slow to develop, can be measured using radioactivity tracer surveys.

TITLE: ***Final Report of an Ambient Air Survey for LSU Sweet Lake, Louisiana***
SUBTITLE: ***July 1980 -May 1982***

AUTHORS: not given
PUBLISHER: Core Laboratories, Inc.
PAGINATION: 115
PUBLICATION DATE: not given
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: P8203A
DESCRIPTORS: Ambient air sampling, Pollutant information, and Meteorological information

SCOPE:

This report documents Core Laboratories', Inc., Lake Charles, Louisiana operation of a single station ambient air quality sampling network in Sweetlake, Cameron Parish, Louisiana. Continuous pollutant information collected included Sulfur Dioxide (SO_2), Hydrogen Sulfide (H_2S), Total Hydrocarbons (THC) and Non-Methane Hydrocarbons (NEHC). Continuous meteorological information collected includes wind direction, wind speed, temperature and rainfall.

TITLE: ***Final Report Gladys McCall Geopressured Well For the Period Oct. 1982 thru Oct 31, 1985***
SUBTITLE: ***Technadril-Fenix & Scisson T-F&S Gladys McCall No. 1 Cameron Parish, Louisiana Geopressured-Geothermal Program***

AUTHORS: Technadril-Fenix & Scisson
PUBLISHER: DOE
PAGINATION: 40
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-80ET27217
DESCRIPTORS: Control systems, Procurement, Flow testing, Drilling, Completion, Workover, and Scale control

SCOPE:

Site work on the first prospect, Gladys McCall, began in December 1980. Drilling of the test well began in May 1981 and was completed in October 1981. This well and the salt water disposal well were located on a site 2.3 miles south of State Highway 82 near the town of Grand Chenier in Cameron Parish, Louisiana in Section 27, T15S, R5W. Shortly after the production tubing was installed in February 1982 and the well perforated, a series of tubing failures began, with the consequence that only one reservoir limit test could be performed through November 1983. A second limit test was performed in November 1983. Long-term testing began in December 1983 and has continued for 95% of the time through October 31, 1985.

TITLE: ***Five Year Research Plan 1988-1992***
SUBTITLE: ***Energy from the Earth Geothermal Energy Program***

AUTHORS: not given

PUBLISHER: United States Department of Energy Geothermal Technology Division
PAGINATION: not given
PUBLICATION DATE: October 1988
SPONSOR: U.S. DOE
REPORT OR CONTRACT#: DOE/CE-0248
DESCRIPTORS: Technical plan, Management plan, and Outcome

SCOPE:

This report describes the overall program structure and planned activities by management and contractors of the geothermal program from 1988 to 1992.

TITLE: ***Future for Geopressured-Geothermal Resources***

AUTHORS: Ramsthaler, Jack and Martin Plum
PUBLISHER: Idaho National Engineering Laboratory and EG&G Idaho
PAGINATION: 11
PUBLICATION DATE: not given
SPONSOR: U.S. DOE
REPORT OR CONTRACT#: DE-AC07-761D01570
DESCRIPTORS: Well development, Well history, Geology, Reservoir, Market/Economic/Financial Analysis, Brine disposal, Surface facilities, Recompilation and Preliminary well test, Long-term reservoir test, Development strategy, and Production

SCOPE:

In this paper, the basis for the predicted positive cash flow at the Hulan Well is presented, and the status of the technology supporting the prediction is summarized. Based on the assumption that the predicted reservoir flow and quality is correct, an additional analysis was conducted to estimate the price of gas at which commercial development would be feasible.

TITLE: ***Final Report***
SUBTITLE: ***Environmental Impact of Geopressure-Geothermal Cogeneration Facility on Wetland Resources and Socioeconomic Characteristics in Louisiana Gulf Coast Region***

AUTHORS: Smalley, Arnold, Fathy M. S. Saleh, Wilbur B. Clarke, and Martin Fontenot

PUBLISHER: DOE
PAGINATION: 117
PUBLICATION DATE: August 1984
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS08-83-NV10353
DESCRIPTORS: Air quality, Geology, Water quality, Chemical analysis, Subsidence, Microseismicty, Subsidence, and Environmental impacts

SCOPE:

The major objective of this research is the establishment of an environmental assessment of the cogeneration facilities installed in the Gladys McCall and Hulin sites located on or near the Southwestern Coast of Louisiana. Our initial intentions included the assessment of air quality changes as a result of gaseous emission and cooling towers' drifts, determination of the effects of disposal of cooling water and brine injection on the quality of both ground and surface waters, changes in the regional lakes' productivities as a result of the waste disposal from the cogeneration facility, assessment of the possible implications of an accidental failure or continuous spill-out, and monitoring the change in the brine composition with time. The operation of a pilot plant for direction filtration of brine is also a long-range goal of this study.

In a preliminary report prepared by the Institute for Environmental Studies of Louisiana State University, assessment of selected geopressured-geothermal prospect areas of the Louisiana Gulf Coast region was made on the basis of the nature and extent of the proposed testing activities and environmental characteristics of each prospect area. Data from existing sources provided information concerning levels of dissolved solids, water salinity, geology and geohydrology. This investigation extends the environmental assessment to such factors as the identification and quantification of the chemical products of the geopressured -geothermal operation and their impacts on the area environment.

Since initiation of this study during the fall of 1983, the initial baseline data have been studied and summarized, and experiments designed or studied to attain the goals stated in this summary. Besides the previously stated objectives, our planned studies have been extended to include an investigation of the effect of the cogeneration operation on the biota of the area.

The most recent report of results of a ten-month study by the U.S. Army Corps of Engineers indicates the existence of pollution of ground water supplies in the coastal areas of Louisiana due to saltwater intrusion from the Gulf of Mexico. Our future studies of environmental effects of the cogeneration operation must also take this factor into consideration.

TITLE: ***Future for Geopressured-Geothermal Resources***

AUTHORS: Ramsthaler, Plum
PUBLISHER: DOE

PAGINATION: 19
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Well development and Economics

SCOPE:

Geopressured-geothermal reservoirs are an alternative energy source which has the potential to become commercially viable in those instances where an existing well has penetrated a high quality reservoir. The Department of Energy's (DOE) Geopressured-Geothermal Energy Program has shown that these reservoirs can produce brine saturated with natural gas over long periods of time and that the gas can be separated and sold. Engineering problems of brine handling and disposal have been solved and a basis for costing has been established. The data obtained to date indicate there are no environmental problems associated with producing the resource. Currently, natural gas prices are too low to commercially develop these reservoirs, but with a modest increase in the price of natural gas, the better wells could have an attractive positive cash flow.

Expectations are that the initial geopressured-geothermal development will occur from those unique situations where a deep well, drilled for gas production, passed through a geopressured-geothermal reservoir. If the well was originally a dry hole or the natural gas reservoir later played out, the well would be a candidate for recompilation as a geopressured-geothermal well. The Bureau of Economic Geology at the University of Texas-Austin (UTA) has estimated that there are about 600 producing wells in Texas which have been drilled through geopressured-geothermal reservoirs, and the Louisiana Geological Survey has estimated there are a similar number of potential geopressured-geothermal wells in Louisiana.

The Hulin Well located in Louisiana is representative of a well which has the potential to produce a commercial quantity of energy from a geopressured-geothermal reservoir. Using information from a geological analysis by the Louisiana Geological Survey, a log analysis by the University of Texas at Austin (UTA)[(1)] a recompilation strategy developed by Oil Technology Services (OTS)[(2)], an automated fluid handling system designed by the Eaton Operating Company (EOC) [(3)], and flow predictions by S-CUBED [(4)], EG&G Idaho [(5)] has calculated the potential for a positive cash flow from this well. Commercial development would depend on evidence of the positive cash flow and verification that the analytical tools used in the analysis properly predicted the well performance. The DOE Geopressured-Geothermal Program* will operate the Hulan Well to add to the data base for predicting well performance and to assess the uncertainty in the analytical tools developed to date.

In this paper, the basis for the predicted positive cash flow at the Hulan Well is presented, and the status of the technology supporting the prediction is summarized. Based on the assumption that the predicted reservoir flow and quality is correct, an additional analysis was conducted to estimate the price of gas at which commercial development would be feasible.

TITLE: ***Gas Content of Gladys Mc Call reservoir Brine***

SUBTITLE: ***A Topical Report***

AUTHORS: Hayden, C.G. and P.L. Randolph
PUBLISHER: Institute of Gas Technology
PAGINATION: 81
PUBLICATION DATE: May 1987
SPONSOR: DOE and Eaton Operating Company
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Gas analyses, Gas production, Gas measurement, and Reservoir brine

SCOPE:

This report addresses two aspects of gas production from Sand # 8. The first is the rate and composition of the produced gas. The second is whether or not the aquifer is saturated with natural gas.

TITLE: ***Gas Saturation in Formation Waters***
SUBTITLE: ***Volume 1 Annual Report for 1980***

AUTHORS: Randolph, Philip, Evelyn Rockar, and Terry Osif
PUBLISHER: Gas Research Institute
PAGINATION: 62
PUBLICATION DATE: May 1981
SPONSOR: Gas Research Institute
REPORT OR CONTRACT#: 5011-321-0140
DESCRIPTORS: Natural gas, Gas production, Gas reservoirs, Brines, Models, Thermodynamics, Saturation, Sampling, Wells, Solubility, Methane, and Carbon Dioxide

SCOPE:

Understanding the chemistry of brines from geopressured-geothermal formations is essential to the determination of the economics of production. This understanding is achieved by obtaining and analyzing down-hole (in-situ) fluid samples. The analytical results are compared to the results of surface sample analysis and to results of thermodynamics modeling of this system.

A series of attempts at down-hole sampling at several DOE Wells of Opportunity culminated with a set of successful samples at the Riddle-Saltine well. Successive modifications to a commercial sampler were suggested and made over a period of several months during which there were also unsuccessful sampling attempts. An understanding of the difficulties to be overcome with down-hole sampling has been achieved. Iron-free samplers with valve designs that prevent opening when the internal pressure exceeds the external pressure as well as vice versa are required in

geopressure-geothermal sampling.

The chemical analysis and gas-to-water ratios obtained at the Riddle-Saltine compared favorably with results of surface analysis. The presence of free gas in the reservoir was confirmed.

The thermodynamic equilibrium code was successfully tested on sample calculations. The code incorporates the Pitzer model of ionic solutions and incorporates data on methane and carbon dioxide solubilities.

TITLE: ***Geologic, Geophysical, and Geochemical Aspects of Site-Specific Studies of the Geopressured-Geothermal Energy Resource of Southern Louisiana***
SUBTITLE: ***Final Report***

AUTHORS: Pilger, Rex H. Jr.
PUBLISHER: Department of Geology Louisiana State University
PAGINATION: 277
PUBLICATION DATE: August 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-79ET27019
DESCRIPTORS: LaFourche Crossing, Seismic survey, Lirette Field Area, and Computer prospecting

SCOPE:

This report consists of three sections dealing with completed work. They include (1) site-specific studies, LaFourche Crossing Prospect, (2) computer graphics approach to geopressured-geothermal prospecting, and (3) diagenesis of geopressured reservoirs, Lirette Field.

TITLE: ***Geopressured Energy Availability***
SUBTITLE: ***Final Report Ap-1457 Research Project 1272-1***

AUTHORS: Swanson, R.K.
PUBLISHER: Electric Power Research Institute
PAGINATION: 121
PUBLICATION DATE: 1980
SPONSOR: Electric Power Research Institute
REPORT OR CONTRACT#: 1272-1
DESCRIPTORS: Geopressured zones, Reservoir considerations, Energy, Brine disposal, Energy utilization, and Economics

SCOPE:

The objective of this work was to investigate near- and long-term prospects that geopressured/geothermal energy sources could become a viable alternative fuel for electric power generation. The work focused on technical questions of producibility and power generation, as well as economic and environmental considerations. The investigators relied heavily on the existing body of information, particularly in geotechnical areas.
Statistical methods were used where possible to establish probable production values.

Potentially productive geopressured sediments have been identified in twenty specific on-shore fairways in Louisiana and Texas. A total of 232 trillion cubic feet (TCF) of dissolved methane and 367 x 10^{15} BTU (367 quads) of thermal energy may be contained in the water within the sandstone in these formations. Reasonable predictions of the significant reservoir parameters indicate that a maximum of 7.6 TCF methane and 12.6 quads of thermal energy may be producible from these potential reservoirs. Natural gas costs from geo-pressured production facilities will apparently range upward of $5/thousand cubic feet (MCF), for the most favorable reservoirs and most optimistic conditions, assuming high values of dissolved methane. The most serious uncertainties in the production of the geopressured resource at the present time are (1) the single-well drainage volume (size of continuous reservoirs) and (2) the actual amount of gas in solution in specific reservoir areas.

Hydraulic turbines can be used to generate a small amount of low-cost electric power. The geothermal energy can also be converted by small wellhead generators, but such power would be economically marginal.

Spent brine disposal in shallow saline aquifers is currently feasible, with costs in the range of 8 to 10 cents/bbl or more. Reinjection into the deep production reservoirs is not a viable technique at the present time.

TITLE: ***Geopressured Geothermal Bibliography***
SUBTITLE: ***Second Edition: Geopressure Thesaurus Volume II***

AUTHORS: Sepehrnoori, Kamy, Frances Carter, Robert Schneider, Steve Street, and Kira McGill
PUBLISHER: Office of Scientific and Technical Information U.S. DOE
PAGINATION: 200
PUBLICATION DATE: May 1983
SPONSOR: DOE
REPORT OR CONTRACT#: AC08-79ET27112
DESCRIPTORS: N/A

SCOPE:

This is a thesaurus of Geopressure-Geothermal terms, definitions, resources and abbreviations. Companion to the Bibliography.

TITLE: ***Geopressured-Geothermal Program Geopressured-Geothermal Drilling and Testing Plan***
SUBTITLE: ***General Crude Oil- Dept of Energy Pleasant Bayou No.2 Well Brazoria County, Texas***

AUTHORS: Geothermal Branch Engineering and Energy Applications Division DOE/Nevada Operations Office
PUBLISHER: U.S. DOE
PAGINATION: 102
PUBLICATION DATE: April 1979
SPONSOR: DOE
REPORT OR CONTRACT#: NVO-194
DESCRIPTORS: Site activities, Occupational health and safety, Drilling operations, Production Testing, Environmental assessment and monitoring program, Permits, Program management, and Reporting

SCOPE:

Preliminary planning document listing the proposed plan of testing for the Pleasant Bayou No. 2 Well. Actual tests run and a summary of results are contained in the Final Report on the same well.

TITLE: ***Geopressured-Geothermal Drilling and Testing Plan***
SUBTITLE: ***Vol. 1 Drilling and Completion; Technadril/Fenix and Scisson-DOE,T/F and S-DOE Gladys McCall No.1 Well Cameron Parish, Louisiana, March 1981***

AUTHOR: DOE
PUBLISHER: U.S. DOE Nevada Operations Office
PAGINATION: 109
PUBLICATION DATE: March 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET27217

DESCRIPTORS: Geothermal geopressure regime, Drilling operating, Drilling program, Disposal well, Environmental monitoring plan, Permits, Occupational health and safety, and Reporting

SCOPE:

Preliminary planning document listing the proposed plan of drilling and testing for the Gladys McCall No. 1 Well. Actual tests run and a summary of results are contained in the Final Report on the same well.

TITLE: ***Geopressured-Geothermal Drilling and Testing Plan***
SUBTITLE: ***Volume II-Testing Plan Technadril-Fenix & Scisson T-F&S/DOE Gladys McCall No.1 well Cameron Parish, Louisiana January 1982***

AUTHORS: not given
PUBLISHER: Technadril- Fenix & Scisson
PAGINATION: 103
PUBLICATION DATE: January 1982
SPONSOR: DOE
REPORT OR CONTRACT#:not given
DESCRIPTORS: Drilling Operations, Geology, Testing phase, Occupational health and safety, Surface facilities, Well completion and perferation, Flow testing, Analytical testing, Recording, and Reporting

SCOPE:

The overall purpose of the T-F&S/DOE Gladys McCall No. 1 Testing Plan is to determine and demonstrate through long-term flow testing the technological and economic feasibility of recovery of methane and the thermal and hydraulic energy associated with geopressured-geothermal fluids, and high-volume brine disposal in more shallow aquifers. This testing plan presents the necessary background information, and the specific details of testing designed to achieve these goals; however, it should be noted that the primary emphasis of the testing herein described is directed to the recovery of natural gas (primarily methane) from geopressured-geothermal brines, and high volume brine disposal.

More specifically, flow testing of the subject geopressured-geothermal test well is planned in three separate and distinct phases as follows: (1) Phase I - Well Cleanup and Initial Flow Test - ,Reservoir Confirmation (ca 1-2 days), (2) Phase II - Reservoir Limit Determination Test (ca 30-120 days), and (3) Phase III - Long Term Demonstration Flow Testing at Commercial Design Rates. A network diagram of the testing phase of the project is given in Figure 1. The successful completion of these testing phases should result -in continued production and sale of natural gas, and facilitate further evaluation of thermal and hydraulic energy recovery potential from geopressured-geothermal brines.

In addition to the achievement of the primary goals, the testing plan is designed to accumulate sufficient data to: (1) characterize and define adequately the nature, size, and thus potential, of the reservoir; (2)characterize analytically the brine and natural gas produced; (3) confirm the adequacy

of the test well and surface facilities design; and (4) define the extent of scaling/corrosion problems associated with the long-term high volume production and disposal of geopressured-geothermal brine, and minimize and control such scaling/corrosion. Finally, the effects (if any) of testing the subject geopressured-geothermal well on the environment will be monitored through concurrent and separate measurements and studies of subsidence, seismicity, and the quality of the air, surface water, ground water, and ecosystems in the area.

TITLE: ***Geopressured-Geothermal Drilling and Testing Plan Vol. 1 Drilling and Completion***
SUBTITLE: ***Dow Chem-DOE Dow/DOE Sweezy No.1 Well Vermillion Parish LA.***

AUTHORS: Geothermal Branch Energy Applications Division DOE/Nevada Operations Office
PUBLISHER: U.S. DOE Nevada Operations Office
PAGINATION: 96
PUBLICATION DATE: November 1980
SPONSOR: U.S. DOE and DOW Chemical Company
REPORT OR CONTRACT#: NVO-216
DESCRIPTORS: Program management, Site activities, Occupational health and safety, Drilling operations, Production testing, Environmental monitoring plan, Permits, and Reporting

SCOPE:

Preliminary planning document listing the proposed plan of drilling and testing for the Sweezy No.1 Well in Vermilion parish. Actual tests run and a summary of results are contained in the Final Report on the same well.

TITLE: ***Geopressured-Geothermal Energy Development: Social and Economic Issues***
SUBTITLE: ***Geopressured-Geothermal Technical Paper No. 3***

AUTHORS: Orzech, Ann (project manager)--- RPC, Inc.
PUBLISHER: The General Land Office of Texas
PAGINATION: 47
PUBLICATION DATE: July 1979
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FG05-78ET28464
DESCRIPTORS: Social and economic effects, Special issues, and Resource development on PFSL

SCOPE:

This paper presents information relevant to rule-making for geopressured-geothermal development on state-owned lands. The analysis is focused on those potential social and economic effects of resource development, if any, which may require special attention during the leasing and permitting process.

For the most part, many of the expected socioeconomic impacts are not unique to geothermal development, but are already being felt by residents of the fairways because of ongoing developmental activities. The social and economic impacts likely to result from resource development depend upon characteristics specific to the site and surrounding social and economic systems. Specific impacts and their probability, magnitude, and duration can only be determined through a case-by-case analysis.

TITLE: ***Geopressured-Geothermal Energy Investigations in SE Lafourche Parish and Adjacent Jefferson Parish, Louisiana***
SUBTITLE: ***A Thesis***

AUTHOR: Hixon, Robert Louis
PUBLISHER: Department of Geology Louisiana State University
PAGINATION: 92
PUBLICATION DATE: December 1979
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressures, Geology, and Physical parameters

AUTHOR'S ABSTRACT:

A Miocene stratigraphic section in Lafourche Parish and adjacent Jefferson Parish, penetrated by numerous wells, was examined from about -5,000 to -21,000 feet for its geopressured-geothermal energy potential. Thirty computer-generated maps, three hand-drawn maps, seven cross-sections and three graphs were made and lithology, structure, pressure, temperature and salinity were compared.

The investigation revealed geologic anomalies in the vicinity of the salt domes and suggested a promising geopressured-geothermal energy prospect in the Grandison area. Most of the area received abundant deposits of sand throughout the Cenozoic era. The abundance of sand allows the dissipation of high pressures and temperatures, reducing the energy potential elsewhere. If a geopressured-geothermal resource is present, it would have to be at great depths.

TITLE: ***Geopressured-Geothermal Energy Resource Appraisal: Hydrogeology and Well Testing Determine Producibility***
SUBTITLE: ***Guidebook Series No. 2 September 1982***

AUTHORS: Wallace, Raymond H. Jr. --**EDITOR**
PUBLISHER: Geological Society of America
CONFERENCE TITLE: 1982 Annual Meeting of the Geological Society of America
PAGINATION: 111
PUBLICATION DATE: September 1982
SPONSOR: Geological Society of America
REPORT OR CONTRACT#: N/A
DESCRIPTORS: Producibility, Hydogeology, Geopressured-Geothermal resources, Environmental monitoring, and Gladys McCall

SCOPE:

This field trip offers participants the unique opportunity to examine a nonconventional use of the science of hydrogeology. Instead of focusing on problems associated with the relatively shallow fresh ground-water resource, hydrogeology in this case is being applied to achieve an understanding of deep sedimentary basin conditions as they relate to the occurrence and production of geopressured-geothermal energy. Nonconventional aspects of aquifers that contain this energy resource include water temperatures that would exceed the boiling point at the surface, variable salinities ranging from less than 10,000 mg/L to more than 270,000 mg/L, and above normal fluid-pressure gradients that may approach lithostatic (1.0 lb/in /ft) conditions. Problems associated with the production of the thermal, mechanical, and dissolved-methane energy in these waters involve the accurate appraisal of the physical and chemical properties of both fluids and rocks, achieving high-volume flow rates (40,000 bbls/d) from deep wells drilled to 10,000 ft or more, and safe disposal of large volumes of spent brine into shallow saline aquifers. Hydrogeologic knowledge is also required to properly address the environmental problems anticipated to result from production, such as the potential for land-surface subsidence.

To gain an appreciation of these problems, a producing geopressured-geothermal test well, the Technadril-Fenix and Scisson-DOE, Gladys McCall No. 1, will be visited in Cameron Parish, Louisiana. Operation of the production well, surface test facility and brine-disposal system will be observed and explained. The sophisticated electronic data recording and well-monitoring systems will also be inspected, and well-test results achieved will be reviewed.

The drive to reach the well site will traverse the south Louisiana coastal plain, beneath which lie some of the largest resources of fresh ground-water in the nation, as well as much of the nation's hydrocarbon reserves. An examination of the surface physiography and coastal marsh environment near the well-site will clearly demonstrate why land-surface subsidence is of major concern to development of the geopressured-geo-thermal resource. This is the "breadbasket" of the seafood industry in the area of the Gulf of Mexico and the southern terminus of the Mississippi Flyway for many species of migratory water fowl. Minor subsidence could convert land into water-bottom and change fresh-water marsh into saltwater marsh, thus disrupting a fragile ecosystem. For this reason, an extensive environmental monitoring system has been developed and constructed as part of this well test.

It is hoped that this field trip will spark an enlightening exchange of ideas and constructive debate between scientists and engineers from the hydrologic and petroleum disciplines. The science and technology of geopressured-geothermal resource recovery has largely been based on the considerable knowledge and experience gained by the petroleum industry in exploration for and production of conventional oil and gas resources. However, the volumes of fluids extracted for use and the volumes of waste brines reinjected by the industry are low in comparison to the volumes

anticipated for economic recovery of geopressured-geothermal energy. Development of a new technology incorporating contributions from both the hydrologic and petroleum disciplines, will most probably be required for any future exploitation of this resource.

TITLE: ***Geopressured Geothermal Performance and Cost Model: Documentation of Version IMGPR-1.0***

AUTHORS: not given
PUBLISHER: Meridian Corporation
PAGINATION: 64
PUBLICATION DATE: September 1992
SPONSOR: Sandia National Laboratory
REPORT OR CONTRACT#: AA-7204
DESCRIPTORS: Methane-laden hot brine, Hydraulic energy, and Geopressured resources

AUTHOR'S ABSTRACT:

"IMGPR" is the geopressured resources version of the "IMGEO" series of models of the performance and cost of electricity from geothermal resource systems. "IM" stands for "Impacts of Research"; "GEO" for "geothermal", and "GPR" for "geopressured."

IMGPR-1.0 simulates the depletion of methane-laden hot brine and the drawdown of reservoir pressure from a two-dimensional circular geopressured reservoir. Heat, methane and hydraulic energy in the fluid are converted to electricity. The levelized busbar price for electricity is found via revenue requirements calculations, The model searches among well flow rates ranging from 1,000 to 40,000 barrels per day, sizes equipment to meet the flow rate, and finds the flow rate at which the cost of electricity is lowest. Project lifetime is allowed to range from 1 to 20 years.

The results indicate that the resource covered is not terribly large, and the cost of electricity relatively expensive. The base case results include 4,000 MW at a weighted average cost of 6.1 cents per kilowatt hour. The risked case results include 1,600 MW at a weighted average cost of 17.1 cents per kilowatt hour. Although the Liberty Harris site appears somewhat attractive in the base case, the more probable results for Liberty Harris (the risked case) are much less so.

TITLE: ***Geopressured-Geothermal Production Test Plan***
SUBTITLE: ***Phase II Pleasant Bayou No. 2 Well Brazoria County, Texas***
AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 54
PUBLICATION DATE: July 1981
SPONSOR: DOE Nevada Operations Office and Geopressure Projects Office

REPORT OR CONTRACT#: not given
DESCRIPTORS: Reservoir testing, Data Acquisition, Environmental assessment and monitoring, and Chemical analysis

SCOPE:

Phase II testing was designed to produce at a rate of 30,000 B/D to evaluate the capabilities of the geopressured-geothermal reservoir. Tests were conducted to determine reservoir areal extent; aquifer fluid properties and their physical and chemical changes with production; information on reservoir production drive mechanism; long-term scale and corrosion control methods; disposal well operation; and possible environmental effects of a long-term test.

Surface equipment modifications to ensure capability for high-volume production included installing a second separator, replacing the 4-inch disposal line with a 6-inch line, installing chemical inhibitor injection equipment, and installing a dehydrating unit for gas pipelining.

TITLE: ***Geopressured-Geothermal Program Geopressured-Geothermal Drilling and Testing Plan Volume II Testing Plan***
SUBTITLE: ***Dow Chemical Co.-Dept. Of Energy Dow-DOE Sweezy No.1 Well Vermilion Parish, Louisiana***

AUTHORS: Dow Chemical Co.
PUBLISHER: U.S. DOE Nevada Operations Office
PAGINATION: 149
PUBLICATION DATE: February 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-79ET27255
DESCRIPTORS: Reservoir testing and evaluation, Occupational health and safety, and Environmental monitoring plan

AUTHOR'S ABSTRACT:

The Dow /D.O.E. L. R. Sweezy No. 1 geopressured geothermal production well was completed in August of 1981. The well was perforated and gravel packed in approximately 50 feet of sand from 13,344 feet to 13,395 feet. Permeabilities of 6 to 914 millidarcies were measured with porosity of 25 to 36%. Static surface pressure after well clean-up was 5000 psi. At 1000 B /D flow rate the drawdown was 50 psi. The water produced in clean-up contained 100,000 ppm TDS.

This report details the plan for testing this well with the goal of obtaining sufficient data to define the total production curve of the small, 939 acre, reservoir. A production time of six to nine months is anticipated. The salt water disposal well is expected to be completed and surface equipment installed such that production testing will begin by April 1, 1982. The program should be finished and reports written by February 28, 1983.

The brine will be produced from the No. 1 well, passed through a separator where the gas is removed, then reinjected into the No. 2 (SWD) well under separator pressure. Flow rates of up to 25,000 B/D are expected. The tests are divided into a two-week short-term test and six to

nine-month long-term tests with periodic downhole measurement of drawdown and buildup rates.

Data obtained in the testing will be relayed by phoneline computer hookup to Otis Engineering in Dallas, Texas where the reservoir calculations and modeling will be done. At the point where sufficient data has been obtained to reach the objectives of the program, production will be ended, the wells plugged and abandoned, and a final report will be issued.

TITLE: ***Geopressured Geothermal Subsidence Study***
SUBTITLE: ***Preliminary Phase B Report***

AUTHORS: not given
PUBLISHER: EDAW-ESA
PAGINATION: 112
PUBLICATION DATE: August 1980
SPONSOR: Lawrence Berkeley Laboratories
REPORT OR CONTRACT#: 4501810
DESCRIPTORS: Socioeconomic features, Subsidence estimation, Impacts and issues, and Mitigation measures

SCOPE:

Subsidence is one of the most potentially significant impacts associated with projected development of the Gulf Coast geopressured geothermal (abbreviated Geo2) resources. In 1978-1979, EDAW-ESA studied environmental effects of subsidence due to fluid withdrawal, and found that urban coastal areas such as Houston were especially susceptible to certain types of subsidence-related damage, especially flooding. Because many of the geopressured fairways are located along or near the coast, relatively small amounts of subsidence (1 to 3 feet) could result in potentially large economic losses. If the location and amount of possible subsidence could be reliably estimated prior to development, appropriate mitigation or preventive measures could be taken.

The purpose of the present study is to develop a research plan (Phase C report), identifying areas where additional research is needed for prediction of subsidence amounts, location, and effects due to geopressured development. The basis for the recommended research program (this Phase B report) is an analysis of subsidence potential and environmental conditions at representative geopressured sites in Texas and Louisiana. An earlier Phase A report described these representative sites which were selected for more detailed study and what criteria were used to select them, in accordance with the Scope of Work in LBL Subcontract No. 4501810.

This Phase B report presents results of subsidence predictions prepared using reasonable geopressured geothermal development scenarios for several candidate development areas. It also provides an assessment of the potential environmental and socioeconomic impacts at candidate areas and an inventory of currently available mitigation measures.

Based on the first two studies, a research plan is being drawn up (Phase C) that is aimed at reducing uncertainties in subsidence and impact evaluations, so that future impact predictions will be as definitive as current understanding of the subsidence phenomenon permits.

TITLE: ***Geopressure-Geothermal Testing Plan***
SUBTITLE: ***Magma Gulf-Technadril/DOE Amoco Fee No. 1 Well Sweet Lake Prospect Cameron Parish, La-June 1981***

AUTHORS: Durrett, Larry R. and C.O. Durham, Jr.
PUBLISHER: Magma Gulf-Technadril
PAGINATION: 123
PUBLICATION DATE: June 1981
SPONSOR: DOE
REPORT OR CONTRACT#: ET-78-C-08-1561
DESCRIPTORS: Drilling operations, Occupational health and safety, Surface facilities, Completion and perforation, Flow testing, and Analytical testing

SCOPE:

The overall purpose of the MG-T/DOE AMOCO Fee No. 1 testing program is to determine and demonstrate through long-term flow testing the technological and economic feasibility of recovery of methane and the thermal and hydraulic energy associated with geopressured-geothermal fluids, and high-volume brine disposal in more shallow aquifers. This testing plan presents the necessary background information, and the specific details of testing designed to achieve these goals; however, it should be noted that the primary emphasis of the testing herein described is directed to the recovery of natural gas (primarily methane) from geopressured -geothermal brines, and high-volume brine disposal.

More specifically, flow testing of the subject geopressured-geothermal test well is planned in three separate and distinct phases as follows: (1) Phase I - Initial Flow Test - Reservoir Confirmation Test (ca 1-2 days), (2) Phase II - Reservoir Limit Determination Test (ca 10-20 days), and (3) Phase III - Long-term Demonstration Flow Testing at Commercial Design Rates (ca 150+ days). A network diagram of the Testing Phase of the project is given in Figure 0. The successful completion of these testing phases will obviously result in continued production and sale of natural gas, and facilitate further evaluation of thermal and hydraulic energy recovery potential from geopressured-geothermal brines.

In addition to the achievement of the primary goals, the testing plan is designed to accumulate sufficient data to: (1) characterize and define adequately the nature, size, and thus potential, of the reservoir, (2) characterize analytically the brine and natural gas produced, (3) confirm the adequacy of the test well and surface facilities design, and (4) define the extent of scaling/corrosion problems associated with the long-term high-volume production and disposal of geopressured-geothermal brine, and to minimize and control such scaling/corrosion. Finally, the effects (if any) of testing the subject geopressured-geothermal well on the environment will be monitored through concurrent and separate measurements and studies in the areas of subsidence, seismicity, and the quality of the air, surface water, ground water, and ecosystems in the area.

TITLE: ***Geopressured-Geothermal Well Report***

SUBTITLE: ***Volume II- Well Workover and Production Testing for the Period February 1982- October 1985 T-F&S/DOE Gladys McCall No. Well Cameron Parish, Louisiana***

AUTHORS: not given
PUBLISHER: Technadril-Fenix & Scisson
PAGINATION: 976
PUBLICATION DATE: not given
SPONSOR: U.S. DOE
REPORT OR CONTRACT#: DE-AC07-80ET27217
DESCRIPTORS: Geology, Petrophysics, Well Drilling/Workover, Well logging, Perforation, Completion operation, Surface facilities, and Well production

SCOPE:

This report is a follow-on report covering well production testing operations and necessary well workover operations during the February 1982- October 1985 period, and is a final report by Technadril Fenix & Scisson on the Gladys McCall prospect.

The primary goals of the well testing program were (1) to determine reservoir size, shape, volume, drive mechanism, and other reservoir parameters, (2) to determine and demonstrate the technological and economic viability of producing energy from a geopressured-geothermal brine aquifer through long-term production testing, and (3) to determine problem areas associated with such long-term production, and to develop solutions therefore.

TITLE: ***Geopressured Reservoir Simulation***
SUBTITLE: ***Final Draft Report (Year 3)***

AUTHORS: Pritchett, J.W., S.K. Garg, M.H. Rice, and T.D. Riney
PUBLISHER: S-Cubed
PAGINATION: 127
PUBLICATION DATE: June 1979
SPONSOR: DOE
REPORT OR CONTRACT#: CY-76-C-5040-1S
DESCRIPTORS: Methane brine-mixtures, Two-phase near-wellbore flow, Geopressure Geothermal reservoir simulator, and Parametric calculations

SCOPE:

This report describes work performed by Systems, Science and Software (S-Cubed) in support of the parallel reservoir modeling activities by the University of Texas at Austin. It represents the final technical report for the Year 3 of this joint effort to develop and apply techniques for predicting the performance of geopressured geothermal reservoir systems.

TITLE: ***Geopressured Reservoir Testing: Edna Delcambre No. 1 Well***
SUBTITLE: ***Final Report***

AUTHORS: Wolgemuth, K.M., U. Ahmed, J.F. Schatz, and A.H. Jones
PUBLISHER: Terra Tek
PAGINATION: 73
PUBLICATION DATE: June 1980
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-01-4060
DESCRIPTORS: Re-completion procedures, Well test procedures, Gas and water analysis, Reservoir engineering analysis, and Reservoir assessment

AUTHOR'S ABSTRACT:

The Edna Delcambre No. 1 Well (Tigre Lagoon Gas Field, Vermilion Parish, Louisiana) was the first well tested in a geopressured reservoir under the Well-of-Opportunity program sponsored by the Department of Energy/Division of Geothermal Energy. During the spring and summer of 1977 the well was recompleted in two geopressured sand aquifers at 12,600 and 12,900 foot depth and flow-tested over a period of about six weeks. The tests were a success in terms of achieving desired operations. Bottomhole pressure was about 11,000 psi; the well was flowed at rates in excess of 10,000 BWPD; surface flowing temperature was about 220°F; and salinity was about 120,000 mg/l. The natural gas content (mostly methane) of the brine ranged from about 17 SCF/bbl to greater than 200 SCF/bbl. Methane solubility was about 24 SCF/bbl, which indicated that much of the flow carried significant amounts of excess gas. Subsequent data analysis indicated that in one of the tested aquifers free gas stringers existed and in the other aquifer, free gas reached the well by inter-formation leakage from a nearby well and indirect contact with a gas cap. Transient pressure data were analyzed to determine reservoir engineering parameters. Permeability-thickness products were 2000-3000 md-ft. Reservoir production capability was high, but methane in excess of about 24 SCF/bbl could not in the long run be expected from the aquifers themselves.

TITLE: ***Geothermal Direct Use Engineering and Design Guidebook***

AUTHORS: Leinau, Paul J. and Ben C. Lunis--**EDITOR**
PUBLISHER: Geo-Heat Center Oregon Institute of Technology
PAGINATION: 401
PUBLICATION DATE: March 1989
SPONSOR: DOE- Idaho Operations Office
REPORT OR CONTRACT#: DE-FG07-87ID 12693
DESCRIPTORS: Geothermal resources, Fluid sampling techniques, Drilling and well construction, Well pumps, Materials, Heat exchangers, Space heating equipment, Heat pumps,

Absorption refrigeration, Greenhouses, Aquaculture, Industrial applications, Engineering cost analysis, Regulatory and commercial aspects, and Environmental considerations

SCOPE:

The Geothermal Direct Use Engineering and Design Guidebook is designed to be a comprehensive, thoroughly practical reference guide for engineers and designers of direct heat projects. These projects could include the conversion of geothermal energy into space heating and cooling of buildings, district heating, greenhouse heating, aquaculture and industrial processing.

The initiative to create this Guidebook came from the Geo-Heat Center, with support from the United States Department of Energy under grant number DE-FG07-871D 12693, and from the Idaho National Engineering Laboratory (INEL) under contract number DE-AC07-761D01570 for the purpose of communicating information concerning the conversion of geothermal energy into direct use applications. This information, which was primarily acquired through assisting developers on many geothermal-direct use projects since 1978, was heretofore uncoordinated and diffuse. The Guidebook attempts to impart a comprehensive understanding of information important to the development of a geothermal direct use project. The text is aimed primarily to the mechanical engineer or technical person responsible for project design. The intent is that the contents should be of a practical and technical nature and answer questions most commonly asked by engineers designing direct use projects. In addition, the authors hope that the Guidebook will be useful to a wide circle of persons interested in topics ranging from; geology, exploration, well drilling, reservoir engineering, mechanical engineering, engineering cost analysis to regulatory codes, and environmental aspects. Special attention has been paid to unification of expert knowledge drawn from years of experience in order to ensure an integrated view of direct uses of geothermal energy.

The Guidebook is directed at understanding the nature of geothermal resources and the exploration of these resources, fluid sampling techniques, drilling, and completion of geothermal wells through well testing, and reservoir evaluation. It presents information useful to engineers on the specification of equipment including well pumps, piping, heat exchangers, space heating equipment, heat pumps and absorption refrigeration. A compilation of current information about greenhouse, aquaculture and industrial applications is included together with a discussion of engineering cost analysis, regulation requirements, and environmental considerations.

The purpose of the Guidebook is to provide an integrated view for the development of direct use projects for which there is a very large potential in the United States.

TITLE: ***Geothermal Energy R&D Program***
SUBTITLE: ***Annual Progress Report for the Fiscal Year 1990--Final Report***
AUTHORS: Meridian Corporation
PUBLISHER: DOE Geothermal Division
PAGINATION: 110
PUBLICATION DATE: March 1991
SPONSOR: DOE Geothermal Division
REPORT OR CONTRACT#: DE-AC01-86CE30844
DESCRIPTORS: Hydrothermal, Geopressured-Geothermal, Hot dry rock, and Magma energy

SCOPE:

This Annual Progress Report presents the research and development accomplishments of the Geothermal Energy R&D Program during Fiscal Year 1990. Its purpose is to provide a record of progress made toward meeting the research objectives established within each geothermal resource category. The report summarized geothermal activities funded and directed by the Geothermal Division. Detailed information on the specific activities can be obtained by referring to the individual annual progress reports prepared by the research organizations or published technical papers which resulted from the research efforts.

Section I of the report presents an overview of the Geothermal Energy R& D Program. It includes a summary of the program methodology employing research objectives, the program elements, and the program budget and management. Section II presents the FY90 achievements within each resource category (hydrothermal, geopressured-geothermal, hot dry rock, and magma energy). The project description, applicable research objectives, fiscal year accomplishments, and future plans are presented in the report for each project in the FY90 R&D program. Appendix A contains the key participants lin the Geothermal Program. Appendix B consists of a listing, by resource category, of major reports and papers published as a result of the FY90 research activities.

TITLE: ***Geothermal Technology Evolution Rationale for the National Energy Strategy***

AUTHORS: not given
PUBLISHER: Geothermal Division Office of Utility Technologies DOE
PAGINATION: 45
PUBLICATION DATE: October 1990
SPONSOR: DOE Geothermal Division Office of Utility Technologies
REPORT OR CONTRACT#: not given
DESCRIPTORS: Hydrothermal and Hot dry rock

SCOPE:

This document contains the rationale for projections of cost, performance, and market penetration by geothermal electric technology in various cases of the National Energy Strategy (NES). The rationale supplements the earlier document, Renewable Energy Technology Characterizations, September 10, 1990, and other submissions by the DOE Geothermal Division in conjunction with NES analysis activities.

Section 1 reviews the nature and extent of geothermal resources, basic components of geothermal energy systems, achievements to date, status of the industry, and market conditions for geothermal development. Section 2 addresses figures of merit for evaluating the economic viability of geothermal electric projects; technology trends affecting cost are also given. Section 3 examines three scenarios of projected change in cost and performance, based on the judgment of DOE and independent experts: a base case in which recent trends in industry and technology improvement continue in a business-as-usual manner; an accelerated R&D case in which the pace and scope of technology improvements by the federal program are increased; and an augmented case in which hot dry rock technology is developed as a logical follow-on to hydrothermal technology. Finally, Section 4 presents the rationale for achieving the improvements in the near- to long-terms.

TITLE: ***Geothermal Well Log Interpretation State of the Art***
SUBTITLE: ***Final Report***

AUTHORS: Sanyal, S.K., L.E. Wells, and R. E. Bickham
PUBLISHER: Los Alamos Scientific Laboratory
PAGINATION: 321
PUBLICATION DATE: January 1980
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: W-7405-ENG
DESCRIPTORS: Geothermal reservoir types, Data acquisition, and Interpretation techniques

SCOPE:

An in-depth study of the state of the art in Geothermal Well Log Interpretation has been made encompassing case histories, technical papers, computerized literature searches, and actual processing of geothermal wells from New Mexico, Idaho, and California. A classification scheme of geothermal reservoir types was defined which distinguishes fluid phase and temperature, lithology, geologic province, pore geometry, salinity, and fluid chemistry.

Major deficiencies of Geothermal Well Log Interpretation are defined and discussed with recommendations of possible solutions or research needed for solutions.

The Geothermal Well Log Interpretation study and report has concentrated primarily on Western U. S. reservoirs. Geopressured geothermal reservoirs are not considered.

TITLE: ***Geothermal Well Site Restoration and Plug Abandonment of Wells***
SUBTITLE: ***DOE Gladys McCall Test Site Cameron Parish, Louisiana and DOE Willis Hulin Test Site Vermilion Parish, Louisiana***

AUTHORS: Rinehart, Ben N.
PUBLISHER: EG&G Idaho and Idaho National Engineering Laboratory
PAGINATION: 228
PUBLICATION DATE: August 1994
SPONSOR: DOE
REPORT OR CONTRACT#: EGG-EP-11414
DESCRIPTORS: Restoration, Plugging of water wells, NORM, and Plug and abandonment

AUTHOR'S ABSTRACT:

A report is presented on the final phase of an energy research program conducted by the U.S. Department of Energy (DOE) involving two geothermal well sites in the State of Louisiana the Gladys McCall site and the Willis Hulin site. The research program was intended to improve

geothermal technology and to determine the efficacy of producing electricity commercially from geopressured resource sites. The final phase of the program consisted of plug and abandonment (P&A) of the wells and restoration of the well sites. Restoration involved (a) initial soil and water sampling and analysis; (b) removal and disposal of well pads, concrete, utility poles, and trash; (c) plugging of monitor and freshwater wells; and (d) site leveling and general cleanup. Restoration of the McCall site required removal of naturally occurring radioactive material (NORM), which was costly and time-consuming. Exhibits are included that provide copies of work permits and authorizations, P&A reports and procedures, daily workover and current conditions reports, and cost and salvage reports. Site locations, grid maps, and photographs are provided.

TITLE: ***Geohydraulic Energy From Geopressured Aquifers***
SUBTITLE: ***A Thesis***

AUTHORS: Parmigiano, John Michael
PUBLISHER: Louisiana State University Department of Petroleum Engineering
PAGINATION: 104
PUBLICATION DATE: 1973
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Wells, Groundwater, and Hydraulics

AUTHOR'S ABSTRACT:

There is currently interest in the feasibility of utilizing hydraulic horsepower generated at the well heads of flowing water wells, presumably for generating electricity. Water for this purpose would have to be produced from geopressured aquifers because of their ability to produce at much higher rates and at much higher surface pressures than normally pressured aquifers This study was made because there is no known published work which predicts the magnitude of this power, herein called geohydraulic power.

Methods are presented for calculating the surface pressure and flow rate history of several systems. These include single wells in infinite aquifers; and single, cluster and uniformly spaced well systems in finite aquifers. Methods for each system are illustrated using representative data.

Power levels of the order of megawatts per well sustained for many years are predicted. At these levels, preliminary studies indicate the utilization of geohydraulic power may be practicable, either by itself or along with utilization of geothermal energy in the produced water.

TITLE: ***Geothermal and Heavy-Oil Resources in Texas: Direct Use of Geothermal Fluids to Enhance Recovery of Heavy Oil***
SUBTITLE: ***Geological Circular 93-3***

AUTHORS: Seni, Steven J. and Timothy G. Walter
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: 44
PUBLICATION DATE: 1993
SPONSOR: U.S. DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Geopressured-geothermal reservoirs, hot-water flood, Jackson Group, Mirando Trend, Oil plays, South Texas, Thermally enhanced oil recovery, and Wilcox Group

AUTHOR'S ABSTRACT:

In a five-county area of South Texas, geopressured-geothermal reservoirs in the Paleocene-Eocene Wilcox Group lie below medium- to heavy-oil reservoirs in the Eocene Jackson Group. This fortuitous association suggests the use of geothermal fluids for thermally enhanced oil recovery (TEOR). Geothermal fairways are formed where thick deltaic sandstones are compartmentalized by growth faults. Wilcox geothermal reservoirs in South Texas are present at depths of 11 ,000 to 15,000 ft (3,350 to 4,570 m) in laterally continuous sandstones 100 to 200 ft (30 to 60 m) thick. Permeability is generally low (typically 1 md), porosity ranges from 12 to 24 percent, and temperature exceeds 250°F (121 °C).

Reservoirs containing medium (20° to 25° API gravity) to heavy (10° to 20° API gravity) oil are concentrated along the Texas Coastal Plain in the Jackson-Yegua Barrier/Strandplain (Mirando Trend), Cap Rock, and Piercement Salt Dome plays and in the East Texas Basin in Woodbine Fluvial/ Deltaic/Strandplain Sandstone and Paluxy Fault Line plays. The Jackson-Yegua Barrier/Strandplain (Mirando Trend) is the most favorable play for TEOR of medium to heavy oil because of the abundance of candidate reservoirs, relative simplicity of reservoir architecture, and shallow depth of burial. Updip pinch-out of shallow barrier bar/strandplain sandstones largely controls the distribution of medium- to heavy-oil reservoirs in the Jackson Group. Subtle structure, small faults, and sandstone-body pinch-outs form lateral barriers of the reservoirs. Structural, depositional, and diagenetic variations cause reservoir compartmentalization. The medium- to heavy-oil reservoirs are typically porous (25 to 35 percent) and permeable (100 to 1,000 md), slightly clayey, fine- to medium-grained sand and sandstones. Calcite- cemented zones of low porosity (approximately 5 percent) and permeability (approximately 0.01 md) compartmentalize the reservoirs.

Injection of hot, moderately fresh to saline brines will improve oil recovery by lowering viscosity and decreasing residual oil saturation. Smectite clay matrix could swell and clog pore throats if injected waters have low salinity. The high temperature of injected fluids will collapse some of the interlayer clays, thus increasing porosity and permeability. Reservoir heterogeneity resulting from facies variation and diagenesis must be considered when siting production and injection wells within the heavy-oil reservoir. The ability of abandoned gas wells to produce sufficient volumes of hot water over the long term will also affect the economics of TEOR.

TITLE: ***Geothermal Gradient Map of the United States***
SUBTITLE: ***Eastern Half 1982***

TITLE: ***Geothermal Gradient Map of the United States***
SUBTITLE: ***Western Half 1982***

TITLE: ***Geothermal Resources of Texas 1982***
SUBTITLE: ***Map***

AUTHORS: Woodruff Jr., Dwyer, and Gever
PUBLISHER: not given
PAGINATION: N/A
PUBLICATION DATE: 1982
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:
Scale 1:1,000,000, full color

Map depicting the 15 major low-temperature geothermal aquifers in the state. The map was constructed using data from published reports, files of State and Federal agencies, and field measurements. Schematic cross sections showing areal and vertical relations among the aquifers are included, along with measurements of depth, water temperature, water chemistry, and flow rates for selected wells. Areas noted either for past uses or for potential resource development are briefly discussed. The map was prepared by the National Oceanic and Atmospheric Administration, National Geophysical Data Center, for the U.S. Department of Energy, Geothermal and Hydropower Technologies Division.

TITLE: ***Geothermal Gradient Map of the Conterminous United States***
SUBTITLE: ***Map***

AUTHORS: Kron, Andrea and Grant Heiken
PUBLISHER: University of California Los Alamos Scientific Laboratory
PAGINATION: N/A
PUBLICATION DATE: August 1980
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE: N/A

TITLE : ***Gladys McCall Well Closure Site Evaluation***
SUBTITLE: ***Volume I***

AUTHORS: not given
PUBLISHER: Dames and Moore
PAGINATION: not given
PUBLICATION DATE: September 1991
SPONSOR: EG&G Idaho, Inc.
REPORT OR CONTRACT#: not given
DESCRIPTORS: Surface soils, Borehole soils, Surface water, RCRA, and Clean Water Act

SCOPE:

As part of the Geopressure Program, the Department of Energy, Idaho Operations Office (DOE/ID) has been conducting a research and development project using the Gladys McCall site in Louisiana since the late 1970's. The Gladys McCall wells have served the program for more than a decade and the DOE now intends bo discontinue this project and terminate its lease with the landowner. The terms of the current lease require DOE to plug the wells in accordance with all State requirements and return the site to its original marsh condition. To support DOE's actions of well closure and site restoration, E G&G Idaho contracted services to adequately characterize the presence or absence of hazardous constituents which could potentially affect the closure and restoration of the site or DOE's long term liability. This report is a summary of the contractors findings.

TITLE: ***Geopressured-Geothermal Resource Assessment: Testing of the Edna Delcambre No. 1 Well, Tigre Lagoon Field, Vermilion Parish, Louisiana***

AUTHORS: not given
PUBLISHER: CONSAD Research Corporation
PAGINATION: 139
PUBLICATION DATE: October 1979
SPONSOR: U.S. DOE
REPORT OR CONTRACT#: EG-77-C-01-4060
DESCRIPTORS: Geology, On-site operation, Analysis of water and dissolved natural gas, Legal aspects, and Environmental assessment

SCOPE:

Preliminary planning document listing the proposed plan of testing for the Edna Delcambre No.1. Well, Tigre Lagoon field, Vermilion parish LA. Actual tests run and a summary of results are contained in the Final Report on the same well.

TITLE: ***Geopressured Geothermal Reservoir Parameters of the Corpus Christi Fairway, Nueces, San Patricio and Aransas Counties***

AUTHORS: Ritchie, Murray Scott
PUBLISHER: Bureau of Economic Geology The University of Texas at Austin
PAGINATION: 133
PUBLICATION DATE: not given
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geology, Methane solubility, Formation pressure, Salinity, Formation Temperature, Porosity, and Permeability

AUTHOR'S ABSTRACT:

The geopressured, geothermal reservoir parameters of the Corpus Christi Fairway were examined in order to evaluate the potential for geothermal energy production in the form of dissolved methane gas. The principle engineering parameters consists of pressure, salinity and temperature, each being discussed in detail. Formation pressures were estimated from shale resistivity measurements on electric logs; the salinity concentrations were calculated from the spontaneous potential deflection for thick, mostly water saturated, sands; formation temperatures were calculated from bottom hole temperatures on individual logging runs. Porosity and permeability were also examined but only in a qualitative manner.

Considering only temperature pressure and salinity the Corpus Christi Fairway appears attractive in terms of geothermal energy production. However, geological studies indicate sand bodies in the area are inadequate in thickness and lateral extent. Further quantitative analysis on porosity and permeability would have to be made before a proper conclusion could be drawn.

TITLE: ***Heavy Crude Oil Reservoirs in the United States: a Survey***

AUTHORS: Dietzman, D.W., M. Carrales Jr. and C.J. Jirik
PUBLISHER: United States Department of the Interior Bureau of Mines
PAGINATION: 53
PUBLICATION DATE: March 1965
SPONSOR: not given
REPORT OR CONTRACT#: not given

DESCRIPTORS: Field, Formation, Depth, API Gravity of oil, Thickness, Productive wells, Discovery date, and Cumulative production

AUTHOR'S ABSTRACT:

In view of the developments and recent interest in recovering heavy oil, this report was prepared to present general information on more than 2,000 heavy oil reservoirs in more than 1,500 fields in 26 states. Information given on each heavy-oil deposit includes the following items: Field and formation, location, average or range of depth, average API gravity of oil, average thickness of formation, areal extent of field, total productive wells drilled in field, discovery date of field, field status in 1963, cumulative production to Jan. 1, 1964, and all known types of secondary-recovery operations initiated (active and terminated) in the reservoirs.

The geographical location of heavy oil accumulations in the United States is shown by a map, and a brief discussion of 14 different areas is given in the text. As of Jan. 1, 1964, 75 percent of the heavy oil reservoirs in the United States had produced more than 10 billion barrels of oil and are estimated to contain over 90 billion barrels of oil in place. It is also estimated that if the deposits which have had little or no production history, such as the one in Missouri, were included, the total remaining heavy oil in place would be in excess of 150 billion barrels.

To find economical ways of recovering this vast reserve of heavy oil, industry is developing technology in several types of thermal-recovery methods. Some of the general considerations and more suitable limitations in selecting a prospect to study for thermal-recovery techniques are: Lithology, depth, viscosity of reservoir fluids, gravity of oil, reservoir thickness, oil in place, and permeability and porosity.

TITLE: ***High-Resolution, three-Dimensional, Seismic Survey Over the Geopressured-Geothermal Reservoir At Parcperdue, Louisiana***
SUBTITLE: ***Final Report for Period January 1, 1981- July 31, 1985***

AUTHORS: Kinsland, Gary L.
PUBLISHER: University of Southwestern Louisiana Department of Geology
PAGINATION: 282
PUBLICATION DATE: July 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10185
DESCRIPTORS: Geology, Model study, Permitting, Survey design, Signal recording, Reservoir, and Attribute processing

SCOPE:

This seismic project has been in conjunction with the experimental depletion of the geopressured -geothermal reservoir at Parcperdue, Louisiana through the Dow/DOE #1 Sweezy well. The production experiment has been reported by Hamilton and Stanley (1984).

One of the major unknowns in the geopressured-geothermal reservoir exploitation is reservoir extent. Commonly, maps available prior to fluid production are found through depletion data not to describe completely the reservoir being drained by the well. Various discrepancies are possible: 1) unrecognized faults exist which limit the reservoir 2) unrecognized permeability (other than faults) exist (shale outs) 3) permeability barriers, which were thought to be sealing, are leaky.

If a seismic image of the reservoir could be achieved before production and if a second image could resolve changes in the reservoir due to depressurization, then such a multi-image procedure would be a powerful aid in reservoir development. A series of images during the utilization of the reservoir would monitor the depressurization front and allow more judicious reservoir engineering decisions to be made; e.g., placement of subsequent wells, or capital investment in existing wells.

The Parsperdue project was deemed particularly suited to be a test of the ability of two images to resolve the depressurization of the Cibicides jeffersonensis (Cib jeff) sand. A high degree of existing control, both geological and geophysical, indicated the reservoir to be bounded by sealing faults. The experimental depletion to be carried out was to take place in a short time period so that a project of reasonable duration could acquire "before" and "after" seismic data. Calculations of the predicted effect of depressurization on acoustic parameters indicated, though not conclusively, that changes sufficient to be detected were likely to occur.

With this "before" and "after" idea in mind, 3-D and 2-D seismic surveys designed to characterize the reservoir were performed prior to production of the geopressured-geothermal fluids.

Unfortunately, failure of the production well gravel-pack allowing the production string to be filled with sand resulted in early abandonment of the well. At the time of abandonment the reservoir pressure had been depleted only about one-half as much as had been originally planned and analysis of the produced fluids had indicated that the reservoir was undersaturated with respect to gas (methane). As the original calculations on which the feasibility of the "before" and "after" concept were based, relied on the expected pressure drop to either affect a significant change in effective stress in the reservoir or to release gas from saturated solution, the early abandonment of the well resulted in cancellation of any plans for an "after" survey.

The remaining importance of the seismic surveys already performed was in the ability of the seismic technique to provide an accurate characterization of the reservoir geometry and volume for their value in the interpretation of the considerable data achieved from the well prior to failure. Consequently, project efforts after the well failure were concentrated toward these ends and this report is written with the main goal being characterization of the reservoir geometry.

TITLE: ***Hulin Test Plan Review***

AUTHORS: not given
PUBLISHER: not given
PAGINATION: 7
PUBLICATION DATE: November 1988
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

This report is a series of letters to EG&G about proposed tests and logs on Hulin wells that was discussed at LSU on November 15, 1988.

TITLE: ***Hydrocarbon Content of Geopressured Brines The Dow-DOE L.R. Sweezy No. 1, the MG-T/DOE Amoco Fee No. 1, the Pleasant Bayou No. 2, and the T-F&S Gladys McCall No.1***
SUBTITLE: ***Final Report***

AUTHORS: Osif, Terry L.
PUBLISHER: Institute of Gas Technology IIT Center
PAGINATION: 85
PUBLICATION DATE: August 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-79ET 27112
DESCRIPTORS: DOW-DOE L.R. Sweezy No.1, MG-T/DOE Amoco Fee No. 1, Pleasant Bayou No. 2, and T-F&S/DOE Gladys McCall No. 1

SCOPE:

During IGT's involvement with the Wells of Opportunity program, reservoir models were developed to try to answer the question "Is the aquifer saturated?" without using PUT results. This report describes IT's investigation of Design Well data in an attempt to determine if the Design Wells are saturated.

TITLE: ***Hydrocarbons From Geopressured-Geothermal Brines***
SUBTITLE: ***A Special Report***

AUTHORS: Keeley, Dean and John Meriwether
PUBLISHER: University of Southwestern Louisiana Department of Chemistry and Department of Physics
PAGINATION: 16
PUBLICATION DATE: March 1983
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Aromatic condensate

SCOPE:

In the early testing of the fluids from the DOW-DOE L. R. Sweezy #1 geopressured well in Vermilion Parish, Louisiana, we detected the presence of a small amount of condensable

hydrocarbons in the separator gas from the well. These hydrocarbons were trapped from a small amount of the separator gas by means of a series of dry ice -- acetone traps. Analysis of this condensate showed it to be largely aromatic in nature. The production of this primarily aromatic condensate continued over the lifetime of the well. Furthermore, the production of hydrocarbons increased during the lifetime of the well. A "drip pot" trap in the gas line from the separator to the flare began to collect a light oil where before only water had been present. About one month before the demise of the well, due to excessive sand production, the well began to produce heavy oils (Tables 4 and 5). The production of these hydrocarbons could inject a new dimension into the economic equation for geopressured -geothermal brine production.

Interest in the presence and significance of this aromatic condensate in the L. R. Sweezy well prompted us to undertake the task of determining if similar condensates could be obtained from the Pleasant Bayou #2 geopressured-geothermal well in Brazoria County, Texas, and/or from the Gladys McCall #1 geopressured-geothermal well in Cameron Parish, Louisiana. We were interested in correlating any hydrocarbons we collected from these wells with that already obtained from the L. R. Sweezy well.

The early results obtained from the above mentioned wells have prompted this special report. Findings have been sufficiently surprising and potentially significant to make us believe that they should be immediately conveyed to the appropriate DOE officials for their information and evaluation.

TITLE: ***Hydrocarbon Solubility and its Migration Processes: A look at the Present Status***

AUTHORS: Mamum, Chowdhury K., Hiroshi Ohkuma, and Kamy Sepehrnoori
PUBLISHER: Center for Energy Studies University of Texas at Austin
PAGINATION: 126
PUBLICATION DATE: December 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC08-85NV10212
DESCRIPTORS: Solubility studies and Migration studies

AUTHOR'S ABSTRACT:

In this study we review the present status of knowledge of solubility of hydrocarbons and its implications on primary migration processes. The intent is to examine the solubility and the transportation mechanisms relevant to geopressured-geothermal reservoirs, although the discussion included here accommodate a wide range of related aspects. Influences of parameters associated with hydrocarbon (especially methane) solubility have been studied. We have sought to evaluate several primary hydrocarbon migration processes and to point out their attractive features as well as their limitations. Nowhere did we intend to reject, accept, or denigrate any mechanism. A brief discussion of hydrocarbon generation processes is also included.

TITLE: ***Hydrogeology of Formations Used for Deep-Well Injection, Texas Gulf Coast***

AUTHORS: Kreitler, Charles, M. Saleem Akhter, Andrew C. A. Donnelly, and Warren T. Wood
PUBLISHER: Bureau of Economic Geology University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: June 1988
SPONSOR: U.S. Environmental Protection Agency
REPORT OR CONTRACT#: CD812786-01-0
DESCRIPTORS: Frio formation, Potentiometric, and Pressure/depth

SCOPE: not given

TITLE: ***Hybrid Power System for Pleasant Bayou Geopressured Well***

AUTHORS: Hughes, Evan E. and Richard G. Campbell
PUBLISHER: Electric Power Research Institute and The Ben Holt Company
PAGINATION: 7
PUBLICATION DATE: not given
SPONSOR: EPRI and DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Isobutane, Pressure reduction turbine, Gas engine, and Binary cycles

SCOPE:

The Electric Power Research Institute (EPRI) has awarded a contract to The Ben Holt Company to design a hybrid power system to be tested at the Pleasant Bayou geopressure well under a project sponsored by both EPRI and the U.S. Department of Energy (DOE). The system will test performance and operation of a concept applicable to hydrothermal as well as geopressured-geothermal resources: use of geothermal heat plus exhaust heat from combustion of fuel to produce power from an organic Rankine cycle (binary cycle), which constitutes a bottoming cycle on the combustion cycle (gas turbine or gas engine). The specific design developed in the EPRI project is based on use of equipment made available by DOE from a previous 500 kWe geothermal field test. Design performance at Pleasant Bayou is based on a 10,000 barrel per day (0.018 m^3/sec) rate of production of brine at 278°F (137°C) containing 19 SCF/barrel (3.41 standard m^3 gas per m brine) methane gas available for combustion in the gas engine. With the addition of a pressure reduction turbine to extract work from the hydraulic pressure drop between the wellhead and the gas separator, the system will produce about 1.3 MWe net power. Gross power outputs of the three generators will be approximately 0.3 MWe from the pressure reduction turbine, 0.6 MWe from the gas engine and 0.5 MWe from the binary cycle, which will use isobutane as the working fluid. The project schedule calls for equipment delivery in June, 1985, installation completed in September, 1985 and operation of the power system test for at least a 6 month period thereafter.

TITLE: ***IT Test Activities on the MG-T/DOE Amoco Fee No. 1 Well During August 1981***

AUTHORS: Hayden, C.G., P.L. Randolph, and T.L. Osif
PUBLISHER: Institute of Gas Technology
PAGINATION: 30
PUBLICATION DATE: October 1981
SPONSOR: DOE, Gas Research Institute, and Magma Gulf-Technadril
REPORT OR CONTRACT#: DOE --DE-AC08-78ET27098, GRI--5011-321-0140
DESCRIPTORS: Reservoir brine, Natural gas, and Brine chemistry

SCOPE:

The first month of production testing of the MG-T/DOE Amoco Fee No. 1 well by the operator suggested gas content of brine of less than half of expected values. However, at the same time, it was recognized that problems existed in flow metering and that some sample analyses provided results inconsistent with understanding from prior tests of other wells. Some of these issues are discussed in the Background section of this report.

During August 1981, IT personnel collected and analyzed samples of gas and brine from the separator during testing of the MG-T/DOE Amoco Fee No. 1 well. Various portions of this work and the related reviews of data developed by participants in the well test were performed in accordance with the statements of work for a) IT's DOE-sponsored project "Computer Simulation of Geopressured Aquifers," b) IT's GRI-sponsored project "Gas From Formation Waters," and c) a purchase order to IT from Magma Gulf-Technadril. In the interest of completeness, and with concurrence of the sponsors, work performed under these projects is consolidated into this single report.

IT's focus was on three questions:
What is the quantity and quality of gas leaving the separator dissolved in the disposal brine?
Is the reservoir saturated with gas?
In what ways does the chemistry of the produced brine affect gas behavior and partitioning between phases?

Achieving meaningful conclusions on these subjects has required substantial departures from the sampling schedule and sample handling procedures prescribed in the procedures manual for geopressured fluids developed for DOE (Ref. 1). For this reason, the procedures used and results of analyses performed are described here in considerable detail. Discussions addressing the above three questions are then presented. Conclusions and recommendations are summarized in the last sections of this report.

TITLE: ***Investigation and Definition of Parameters Associated with Testing Geopressured Water***
SUBTITLE: ***An Interim Report***

AUTHOR: Karkalits, O.C. (Project coordinator), Jimmie Hodges, and Paul H. Jones
PUBLISHER: McNeese State University and Osborn, Hodges, Roberts, and Wieland Engineering
PAGINATION: 91
PUBLICATION DATE: October 1977
SPONSOR: Energy Research & Development Adminstration
REPORT OR CONTRACT#: E-(40-1)-4937
DESCRIPTORS: Geology, Lease and License, Static test plans, and Dynamic test plan

AUTHOR'S ABSTRACT:

Prior to the initiation of this project, considerable literature had appeared in technical journals, particularly geological journals, describing the potential value of the energy combined in hot geopressured waters along the northern Gulf of Mexico coast. The geographic region of interest was identified as the area between Brownsville and Pensacola, approximately 200 miles wide and 750 miles long, and therefore containing about 150,000 square miles of surface area . The resource was estimated as lying at depths between 5,000 and 25,000 feet .

Although many descriptions of this resource hod been written, not much experimental data were available regarding the actual analyses of these waters, especially the methane content. ERDA Geothermal division sponsored. the current project to find out the precise analysis of the waters in the geopressured zone in a specific South Louisiana shut in gas well. This information was desired as a prelude to additional resource development projects. If the experimental results of this project were negative, doubts would be raised that there should be serious attempts at other development projects. If the results were positive (i.e., the waters were saturated with methane suggested by hydro geological theory of this region) then ERDA would feel encouraged to proceed with larger scale projects, especially the drilling and completion of an on purpose geopressured geothermal well.

The project was funded for the purpose of dynamic testing two aquifers tapped by an existing gas well in the Tigre Lagoon field in Vermilion Parish. Some information about the characteristics of the reservoir fluid and the behavior of the reservoir under varying flow conditions was to be obtained. The analyses of the water would be run concurrently with the flow tests.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal Well of Opportunity Prospect No. 5 Fairfax Foster Sutter No.2 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal Inc.
PAGINATION: 38
PUBLICATION DATE: March 1979
SPONSOR: DOE
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Well completion, Well prognosis, Saltwater disposal well, and Plugging and

Abandonment

SCOPE:

This report is a recommendation to acquire and test the well which has been drilled by the Neuhoff Oil and Gas Corporation et al as the Fairfax Foster Sutter No. 2 in Section 6, Township 14S, Range 10E, St. Mary Parish, Louisiana. A detailed completion and testing plan is included in this report.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal Well of Opportunity Prospect No. 5 Fairfax Foster Sutter No.2 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal Inc.
PAGINATION: 38
PUBLICATION DATE: March 1979
SPONSOR: DOE
REPORT OR CONTRACT#: EG-77-C-08-1528

DESCRIPTORS: Well completion, Well prognosis, Saltwater disposal well, and Plugging and Abandonment

SCOPE:

This report is a recommendation to acquire and test the well which has been drilled by the Neuhoff Oil and Gas Corporation et al as the Fairfax Foster Sutter No. 2 in Section 6, Township 14S, Range 10E, St. Mary Parish, Louisiana. A detailed completion and testing plan is included in this report.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-geothermal Reentry Prospect L-3 East Crab Lake Area Cameron Parish, Louisiana Gladys McCall No. 1 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 28
PUBLICATION DATE: April 1978
SPONSOR: DOE
REPORT OR CONTRACT#: EG-77-C-08-1528

DESCRIPTORS: Geology, Reentry technique, Reentry prognosis, Disposal well, Plug and Abandonment

SCOPE:

This report details the completion process for the geopressured-geothermal reentry prospect L-3 East Crab Lake Area Cameron Parish, Louisiana Gladys McCall No.1 Well.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Reentry Prognosis for Geopressure-Geothermal Testing of Gladys McCall No. 1 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 40
PUBLICATION DATE: June 1978
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Geology, Well prognosis, Disposal well, Reentry technique, Plug and abandonment, and Environmental information

SCOPE:

This report is the third revision of the reentry and testing recommendations for the Geo L-2 well in Cameron Parish, Louisiana.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal Well-of-Opportunity Prospect No.1 Lucien J. Richard ET AL No. 1 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 49
PUBLICATION DATE: September 1978
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Geology, Completion prognosis, Mechanical condition, Well test procedures,

Plug and Abandonment

SCOPE:

The following material contains a description of the known mechanical and geological condition of the Lafourche Parish, Louisiana, wellsite which was drilled as a dry hole and subsequently offered as a prospective well-of-opportunity.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Completion Prognosis For Geopressured-Geothermal Well-of-Opportunity Prospect No.4 Tenneco Fee "N" No.1 Well***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 36
PUBLICATION DATE: January 1979
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Well completion, Well prognosis, Saltwater disposal well, Required analysis, and Plug and abandonment procedure

SCOPE:

This report is a recommendation to test the Tenneco Oil Company Fee "N" No. 1 Well. This report provides background information on this WOO prospect.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Reentry Prognosis for Geopressure-Geothermal Testing of the Watkins-Miller No. 1 Well Cameron Parish, Louisiana***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 38
PUBLICATION DATE: August 1978
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EC-77-C-08-1528
DESCRIPTORS: Geology, Reentry technique, Saltwater disposal well, Estimated cost, and Plugging and abandonment

SCOPE:

This report contains a description of the known mechanical and geological condition of the Cameron Parish, Louisiana well site which was drilled as Superior Oil Company-Watkins Miller No. 1.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Detailed Reentry Prognosis For Geopressure-Geothermal Testing of the Watkins-Miller No. 1 Well Cameron Parish, Louisiana***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 16
PUBLICATION DATE: April 1978
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Geology, Reentry technique, Blowout prevention, and Disposal well

SCOPE:

This report contains a description of the known mechanical and geological condition of the Cameron Parish, Louisiana well site which was drilled as Superior Oil Company- Watkins Miller No. 1.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Final Report***

AUTHORS: Hartsock, J.H. and J.A. Rodgers
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 40
PUBLICATION DATE: September 1980
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#:AC08-77ET28460
DESCRIPTORS: Wells proposed, Project operations, and Test results

SCOPE:

This report covers the acquisition, completion, and testing of geopressured-geothermal (Geo2) wells by Gruy Federal, Inc.

TITLE: ***Investigation and Evaluation of Geopressured-Geothermal Wells***
SUBTITLE: ***Plug and Abandonment Report Alice C. Plantation No.2 Well St. Mary Parish, Louisiana***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 14
PUBLICATION DATE: October 1978
SPONSOR: DOE Division of Geothermal Energy
REPORT OR CONTRACT#: EG-77-C-08-1528
DESCRIPTORS: Salt water flow and Disposal well

SCOPE:

The purpose of the report was to present a detailed account of the events which led to the plugging and abandonment of the Alice C. Plantation No. 2, and to set out measures and precautions that Gruy Federal, Inc.(Gruy) had taken to provide every possible assurance that similar events did not occur on subsequent re-entry or well-of-opportunity operations.

TITLE: ***Leveling: Sweetlake Geopressure Test Site Louisiana***

AUTHORS: not given
PUBLISHER: Vernon Meyer & Associates, Inc.
PAGINATION: 268
PUBLICATION DATE: December 1980
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Equipment, Field work, and Methods

SCOPE:

This report documents the first order leveling surveys that were conducted as part of an environmental monitoring program for geopressured test well. The first order leveling was conducted to determine the elevation of the previously installed and leveled bench marks in the area of the Sweetlake geothermal well. All leveling surveys conformed to NGS standards and specifications.

TITLE: ***Leveling: Parcperdue Geopressured Well Site***

AUTHORS: not given
PUBLISHER: Vernon F. Meyer and Associates, Inc.
PAGINATION: 135
PUBLICATION DATE: December 1980
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: Location, Conditions affecting progress, Organization, and Field work

SCOPE:

This report documents leveling surveys that were conducted as part of an environmental monitoring program for geopressured test well. Class B type rod marks were established. First order leveling was conducted to determine the elevation of the installed bench marks and to tie them into the existing first order network. The establishment of marks and leveling surveys conformed to NGS specifications.

TITLE: ***Louisiana Geothermal/Geopressured Energy Resources***
SUBTITLE: ***Resume of Activity***

AUTHORS: not given
PUBLISHER: Louisiana Office of Conservation
PAGINATION: 85
PUBLICATION DATE: June 1977
SPONSOR: Energy Research and Development Administration
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressure-geothermal resource, and Resource development

SCOPE:

This report describes the geopressure-geothermal resource. Research and development activities in Louisiana by both universities and industry are documented in this report. Regulations and legislation were also discussed.

TITLE: ***Management Plan***

AUTHORS: not given
PUBLISHER: Dow Chemical Company Texas Division Hydrocarbons & Energy Research Department
PAGINATION: 58
PUBLICATION DATE: not given
SPONSOR: DOE Nevada Operations Office
REPORT OR CONTRACT#: DE-AC08-779ET27255
DESCRIPTORS: Expected results, Management structure, Technical approach, Technical program, Environmental considerations, Quality control, Control of government owned property, and Property disposal

SCOPE:

This document describes the management functions that were employed in the performance of this contract work.

TITLE: ***Microseismic Monitoring***

AUTHORS: Stevenson, D.A.
PUBLISHER: Louisiana Geological Survey and Louisiana State University
PAGINATION: 34
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Microseismic Monitoring network, Data analysis, Microearthquakes, Seismicity and Well production

SCOPE:

Continuous microseismic monitoring networks have been established around three U.S. Department of Energy (DOE) geopressured-geothermal design wells in southwestern Louisiana since summer 1980 to assess the effects well development may have on subsidence and growth fault activation. The results obtained from this monitoring have shown several unusual characteristics associated with Gulf Coast seismic activity. The observed activity is classified into two dominant types, one with identifiable body phases and the other with only surface wave signatures. The latter type comprises over 99% of the reported 1000+ microseismic event locations. The problem with the slow-moving surface-wave signature events is that rainfall and weather associated frontal passages seem closely related to these periods of seismic activity at all three wells.

After relatively short periods and low levels of flow testing at the Parcperdue and Sweet Lake prospects, seismic monitoring has shown little credible correlation to inferred growth fault locations during periods of flow testing. Longer periods and higher volumes of flow testing at the Rockefeller Refuge prospect should provide a truer indication of induced seismicity attributable to geopressure-geothermal development.

TITLE: ***Microseismic Monitoring of Chocolate Bayou Texas: the Pleasant Bayou No. 2 Geopressured/ Geothermal Energy Test -Well Program***
SUBTITLE: ***1981 Annual Progress Report***

AUTHORS: Mauk, Frederick
PUBLISHER: Teledyne Geotech
PAGINATION: 107
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-ET-27111-8
DESCRIPTORS: Seismograph station, Network design, Analysis procedures, and Microearthquakes

SCOPE:

Commercial utilization of the geopressured brines underlying the Gulf Coast as unconventional geothermal-methane energy sources is dependent upon high volumetric production rates. The production requirements for effective withdrawal and disposal of these highly saline brines is believed to be near 3 X 10^4 bbl/day/well. Such high volumetric productions can alter substantially the ambient state of stress of the local geological column potentially resulting in reactivation of preexisting zones of weakness as well as causing new fracture development.

To investigate normal ambient seismicity as well as potentially enhanced seismic activity induced by brine production, Teledyne Geotech, with the authorization of the Texas Bureau of Economic Geology, has conducted a seismic monitoring program in the vicinity of the Chocolate Bayou geopressured test well (the Pleasant Bayou No. 2) since September 1978. The Pleasant Bayou No. 2 well has been completed and perforated at depths of 14,467 - 14,707 feet (4464.4 - 4482.7 m). The brines produced from the Pleasant Bayou No. 2 well are reinjected at a depth of 6226 - 6538 feet (1897.7 - 1992.8 m) in the Pleasant Bayou No. 1 well. This report describes the seismic monitoring network and results obtained from January through November 1981.

TITLE: ***Microseismic Monitoring of Chocolate Bayou Texas: the Pleasant Bayou No. 2 Geopressured/ Geothermal Energy Test - Well Program***
SUBTITLE: ***1982 Annual Progress Report***

AUTHORS: Mauk, Frederick and R. Alan Davis
PUBLISHER: Teledyne Geotech
PAGINATION: 113
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-ET-27111--9

DESCRIPTORS: Seismic network, Data analysis, and Seismic activity

SCOPE:

Seismological -monitoring of the Chocolate Bayou region of Brazoria County, Texas, in the vicinity of the DOE Pleasant Bayou geopressured/geothermal design well has resulted in significant improvement in assessing the potential seismological hazards and risks associated with development of this alternative energy resource. Since the inception of the monitoring program in 1979, there have been four periods during which significant volumes of brine have been produced from the Pleasant Bayou No. 2 well and subsequently reinjected into the Pleasant Bayou No. 1 well. Continuous seismic monitoring and analyses of the data through 1982 have resulted in the following observations and conclusions. (1) The temporal distribution of seismic events from 1979 through 1982 is not uniform. There is a pronounced increase in the frequency of occurrence of microearthquakes in the latter half of 1981. The distribution of events peaks in the fall months of 1981 and appears to be approximately Gaussian distributed about the peak. (2) Because the increased seismicity follows the Phase I short-term flow test with a delay of over two hundred days and occurs both during and following the aborted Phase II long-term flow test, the exact causality relationship between brine production and/or disposal and induction of microearthquakes is unclear. The coincidence of seismicity and times of brine production and the absence of seismicity in 1982 following a fourteen-month shut-in strongly suggest the existence of a correlation, however. If seismic activity resumes in mid 1983 following the reinitiation of the Phase II long-term flow test on 27 September 1982, there will be additional support for a hypothesized, delayed strain-release response of the local geologic column to the stress perturbation induced by the design well production. (3) The spatial distribution of the seismic epicenters from 1979 through 1982 cluster in the vicinity of proposed locations of growth faults at depths of 15,000 feet west and northwest of the Pleasant Bayou No. 2 well. Depths of the hypocenters are poorly constrained but suggest depths of origin less than that of the production reservoir. These data combined with the few unambiguously recorded first P-wave motions suggest that these microearthquakes occur as dip slip events along growth faults above the production horizon.

TITLE: ***Microseismic Monitoring of Bayou Parcperdue Louisiana: the Dow L.R. Sweezy No.1 Geopressure/Geothermal Energy Test Well Program***
SUBTITLE: ***1982 Annual Progress Report Technical Report No. 83-2***

AUTHORS: Mauk, Frederick, J., Alan R. Davis, and Lori Grant
PUBLISHER: Teledyne Geotech
PAGINATION: 112
PUBLICATION DATE: 1983
SPONSOR: Louisiana Geological Survey and Louisiana State University Department of Geology
REPORT OR CONTRACT#: not given
DESCRIPTORS: Seismic network, Instrumentation, Design, Specifications, Data analysis, Seismic activity, and Seismicity and testing program

SCOPE:

This report describes the operation, data analyses, results and conclusions of the Parcperdue seismic network during the operational period from 1 January through 31 December, 1982.

TITLE: ***Microseismic Monitoring of Bayou Parcperdue Louisiana: The Dow L.R. Sweezy No.1 Geopressured/Geothermal Energy Test Well Program***
SUBTITLE: ***Final Report Technical Report No. 84-2***

AUTHORS: Mauk, Frederick J., Billie Kimball, and Robert Alan Davis
PUBLISHER: Teledyne Geotech
PAGINATION: 78
PUBLICATION DATE: March 1984
SPONSOR: Louisiana Geological Survey and Louisiana State University Department of Geology
REPORT OR CONTRACT#: not given
DESCRIPTORS: Seismic network, Instrumentation, Design, Data analysis, and Seismic activity

SCOPE:

This is the final technical report of the Parcperdue seismic monitoring program. This report defines the experimental procedures, summarizes the observation from 1980 through 1983, and discusses the results and conclusions drawn from analyses of the data.

TITLE: ***Microseismicity Observed at the Bayou Parcperdue Geopressured Well Test Site, August 1-12, 1980***

AUTHORS: not given
PUBLISHER: not given
PAGINATION: 8
PUBLICATION DATE: not given
SPONSOR: Louisiana Geological Survey and DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Site installation, Data collection, Data analysis procedures, and Microseismicity

AUTHOR'S SCOPE:

An experimental geopressured-geothermal well was to be drilled near Bayou Parcperdue in Vermillion Parish, Louisiana. High rate flow testing of this relatively small well-defined reservoir will simulate the effects of long- term production and significantly deplete the reservoir. As a result this project would be more likely than previous tests to induce large cumulative shearing strains in

rock surrounding the reservoir. Localized brittle fracture and accelerated movement on growth faults are possible modes for dissipating this strain.

Magnitudes of the resulting seismic waves and surface subsidence cannot be accurately predicted theoretically, thus they must be closely monitored in the field. A seismic array has been installed by Teledyne Geotech under contract to the Louisiana Geological Survey which will continuously record ground motion in the area. Analysis of these recordings will provide a better understanding of possible risks which might be increased by geopressured- geothermal production.

TITLE: ***Microseismic Monitoring of the Sweet Lake, Louisiana MagmaGulf-Technadril/D.O.E./Amoco Fee No. 1 Geopressured/Geothermal Energy Test Well Program***
SUBTITLE: ***Final Report Covering the Period 20 May 1980- 31 May 1984***

AUTHORS: not given
PUBLISHER: Woodward-Clyde Consultants
PAGINATION: 82
PUBLICATION DATE: May 1984
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Regional geology, Local geology, Field stations, Central recording facilities, Well test data, Data presentation an analysis, and Technical problems

SCOPE:

This final report describes the seismic monitoring network in the vicinity of the Magma Gulf-Technadril/DOE/Amoco Fee No. 1 Geopressured-Geothermal Energy Test Well Program at Sweet Lake, Louisiana. A multi-instrument array to monitor seismicity was designed, installed, and operated at Sweet Lake site. This array was designed to detect microseismicity before, during, and after initial flow testing of the Sweet Lake geopressured/geothermal energy test well.

TITLE: ***Minutes Attached Herein Regarding DOE/Industry Geopressured Geothermal Resource Development***

AUTHORS: not given
PUBLISHER: C.K. GeoEnergy Corporation
PAGINATION: 17
PUBLICATION DATE: January 1978
SPONSOR: DOE

REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

Minutes from meetings called by DOE to explain and solicit participants in the Geopressure-Geothermal project. Also Minutes of various subgroups formed by DOE to solve technical problems, legal, environmental and a range of other problems encountered by contractors and researchers working on the various projects. This report includes comments made at meetings and question and answer sessions if they occurred. Agenda for the meetings are attached.

TITLE: ***Minutes from- DOE/Industry Geopressured Geothermal Resource Development Program Working Group Meeting***

AUTHORS: not given
PUBLISHER: C. K. GeoEnergy Corporation
PAGINATION: 187
PUBLICATION DATE: May 1980
SPONSOR: DOE- Division of Geothermal Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

Minutes from meetings called by DOE to explain and solicit participants in the Geopressure-Geothermal project. Also Minutes of various subgroups formed by DOE to solve technical problems, legal, environmental and a range of other problems encountered by contractors and researchers working on the various projects. These reports include comments made at meetings and question and answer sessions if they occurred. Agenda for the meetings are attached.

TITLE: ***Minutes from-DOE/Industry Geopressured Geothermal Resource Development Program Working Group Meeting***

AUTHORS: not given
PUBLISHER: C.K. GeoEnergy Corporation
PAGINATION: 134
PUBLICATION DATE: March 1981
SPONSOR: DOE- Division of Geothermal Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

Minutes from meetings called by DOE to explain and solicit participants in the Geopressure-Geothermal project. Also Minutes of various subgroups formed by DOE to solve technical problems, legal, environmental and a range of other problems encountered by contractors and researchers working on the various projects. These reports include comments made at meetings and question and answer sessions if they occurred. Agenda for the meetings are attached.

TITLE: ***Minutes from-DOE/Industry Geopressured Geothermal Resource Development Program Working Group Meeting***

AUTHORS: not given
PUBLISHER: C. K. GeoEnergy Corporation
PAGINATION: 168
PUBLICATION DATE: June 1983
SPONSOR: DOE- Division of Geothermal Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

Minutes from meetings called by DOE to explain and solicit participants in the Geopressure-Geothermal project. Also Minutes of various subgroups formed by DOE to solve technical problems, legal, environmental and a range of other problems encountered by contractors and researchers working on the various projects. These reports include comments made at meetings and question and answer sessions if they occurred. Agenda for the meetings are attached.

TITLE: ***Microseismic Monitoring Geopressured Near the Brazoria County Well Test Site***

AUTHORS: not given
PUBLISHER: Teledyne Geotech
PAGINATION: not given
PUBLICATION DATE: March 1980
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Microseismic monitoring and Data collection

SCOPE:

This report briefly describes the monitoring instrumentation and procedures and lists the seismic activity observed during the month of March 1980.

TITLE: ***Minutes From-Doe/Industry Geopressure Geothermal Resource Development Program Working Group Meetings***
SUBTITLE: ***January 1984***

AUTHORS: GeoEnergy Corporation
PUBLISHER: GeoEnergy Corporation
PAGINATION: N/A
PUBLICATION DATE: 1984
SPONSOR: DOE and Holmes & Narver, Inc.
REPORT OR CONTRACT#: not given
DESCRIPTORS: Drilling and Testing

SCOPE:

Minutes from meetings called by DOE to explain and solicit participants in the Geopressure-Geothermal project. Also Minutes of various subgroups formed by DOE to solve technical problems, legal, environmental and a range of other problems encountered by contractors and researchers working on the various projects. These reports include comments made at meetings and question and answer sessions if they occurred. Agenda for the meetings are attached.

TITLE: ***Monte Carlo Simulation of Geopressured Energy Resource***
SUBTITLE: ***A Thesis***

AUTHORS: Abdulrahman, Adnan
PUBLISHER: Louisiana State University Department of Chemical Engineering
PAGINATION: 130
PUBLICATION DATE: May 1982
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Monte Carlo simulation technique, Net present value, and Discounted cash flow rate of return

SCOPE:

The Gulf Coast geopressure reservoirs contain brine with dissolved methane that can be recovered. However the amount available and recoverable are uncertain. Unlike conventional oil and gas exploration and recovery, there is no history or experience in geopressure energy development upon which to base estimates of the economic success of a commercial geopressure venture.

A stochastic Monte simulation technique was developed to account for uncertainty of the

economic and reservoir parameters. Triangular probability distributions were used to approximate the distribution of the random variables in the simulation. The simulation technique was incorporated into an existing computer model of a geopressure venture (Technoeconomical model) and the viability of several proposed geopressure projects was evaluated.

Net present value (NPV) was used as the primary indicator of the profitability of a prospect. Discounted cash flow rate of return (DCFRR) of profitability. The probability distributions of these and other output variables generated from this simulation indicate the risk involved in developing a potential prospect.

The adjustment of methane price (from a base price forecast) needed to achieve a zero NPV for several rates of return was also studied. Sequential completion of multiple sand intervals from a single well was studied to demonstrate a more profitable type of geopressure resource strategy. For a prospect with a large reservoir, simultaneous production with multiple wells from a single reservoir was studied to demonstrate the effect on profitability of increasing the capital investment level beyond that of a single well per reservoir.

The simulation technique was applied to evaluate the viability of the Pleasant Bayou DOE design well in Texas and the prospects LaFourche Crossing, Gladys McCall, and Bayou Hebert in Louisiana.

TITLE: ***Microseismic Monitoring of Chocolate Bayou Texas: the Pleasant Bayou No. 2 Geopressured/ Geothermal Energy Test - Well Program***
SUBTITLE: ***1981 Annual Progress Report***

AUTHORS: Mauk, Frederick
PUBLISHER: Teledyne Geotech
PAGINATION: 107
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-ET-27111-8
DESCRIPTORS: Seismograph station, Network design, Analysis procedures, and Microearthquakes

SCOPE:

Commercial utilization of the geopressured brines underlying the Gulf Coast as unconventional geothermal-methane energy sources is dependent upon high volumetric production rates. The production requirements for effective withdrawal and disposal of these highly saline brines is believed to be near 3×10^4 bbl/day/well. Such high volumetric productions can alter substantially the ambient state of stress of the local geological column potentially resulting in reactivation of preexisting zones of weakness as well as causing new fracture development.

To investigate normal ambient seismicity as well as potentially enhanced seismic activity induced by brine production, Teledyne Geotech, with the authorization of the Texas Bureau of Economic Geology, has conducted a seismic monitoring program in the vicinity of the Chocolate Bayou geopressured test well (the Pleasant Bayou No. 2) since September 1978. The Pleasant Bayou

No. 2 well has been completed and perforated at depths of 14,467 - 14,707 feet (4464.4 - 4482.7 m). The brines produced from the Pleasant Bayou No. 2 well are reinjected at a depth of 6226 - 6538 feet (1897.7 - 1992.8 m) in the Pleasant Bayou No. 1 well. This report describes the seismic monitoring network and results obtained from January through November 1981.

TITLE: ***Microseismic Monitoring of Chocolate Bayou Texas: the Pleasant Bayou No. 2 Geopressured/ Geothermal Energy Test - Well Program***
SUBTITLE: ***1982 Annual Progress Report***

AUTHORS: Mauk, Frederick and R. Alan Davis
PUBLISHER: Teledyne Geotech
PAGINATION: 113
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-ET-27111--9
DESCRIPTORS: Seismic network, Data analysis, and Seismic activity

SCOPE:

Seismological monitoring of the Chocolate Bayou region of Brazoria County, Texas, in the vicinity of the DOE Pleasant Bayou geopressured/geothermal design well has resulted in significant improvement in assessing the potential seismological hazards and risks associated with development of this alternative energy resource. Since the inception of the monitoring program in 1979, there have been four periods during which significant volumes of brine have been produced from the Pleasant Bayou No. 2 well and subsequently reinjected into the Pleasant Bayou No. 1 well. Continuous seismic monitoring and analyses of the data through 1982 have resulted in the following observations and conclusions. (1) The temporal distribution of seismic events from 1979 through 1982 is not uniform. There is a pronounced increase in the frequency of occurrence of microearthquakes in the latter half of 1981. The distribution of events peaks in the fall months of 1981 and appears to be approximately Gaussian distributed about the peak. (2) Because the increased seismicity follows the Phase I short-term flow test with a delay of over two hundred days and occurs both during and following the aborted Phase II long-term flow test, the exact causality relationship between brine production and/or disposal and induction of microearthquakes is unclear. The coincidence of seismicity and times of brine production and the absence of seismicity in 1982 following a fourteen-month shut-in strongly suggest the existence of a correlation, however. If seismic activity resumes in mid 1983 following the reinitiation of the Phase II long-term flow test on 27 September 1982, there will be additional support for a hypothesized, delayed strain-release response of the local geologic column to the stress perturbation induced by the design well production. (3) The spatial distribution of the seismic epicenters from 1979 through 1982 cluster in the vicinity of proposed locations of growth faults at depths of 15,000 feet west and northwest of the Pleasant Bayou No. 2 well. Depths of the hypocenters are poorly constrained but suggest depths of origin less than that of the production reservoir. These data combined with the few unambiguously recorded first P-wave motions suggest that these microearthquakes occur as dip slip events along growth faults above the production horizon.

TITLE: ***National Gas Survey***
SUBTITLE: ***Report to the Federal Energy Regulatory Commission by the Supply-Technical Advisory Task Force on Nonconventional Natural Gas Resources Sub-Task Force 1-Gas Dissolved in Water***

AUTHORS: not given
PUBLISHER: DOE Federal Energy Regulatory Commission
PAGINATION: 66
PUBLICATION DATE: March 1979
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Regional planning, Resource definition, Technology and development, and Environmental control

SCOPE:

This report describes the strategy of the DOE research and development program that will provide sufficient information about geopressured-geothermal resources and be used to encourage private industry to develop and utilize geopressured energy resources.

TITLE: ***Natural and Induced Microseismicity in Southeast Louisiana***
SUBTITLE: ***A Summary and Review***

AUTHORS: Nunn, Jeffery
PUBLISHER: Louisiana State University Department of Geology
PAGINATION: 23
PUBLICATION DATE: not given
SPONSOR: Louisiana Geological Survey
REPORT OR CONTRACT#: not given
DESCRIPTORS: Microseismicity, Cultural noise, Geological limitations, Network design limitations, Teleseisms microseismicity, Natural microseismicity, and Induced microseismicity

SCOPE:

Microseismic monitoring of the regions around the Dow L. R. Sweezy No. 1 Well (Bayou Parcperdue), the Sweet Lake D.O.E./Amoco Fee No.1 well (Sweet Lake) and the Grand Chenier D.O.E./Gladys McCall No. 1 Well (Rockefeller Refuge) in Southwest Louisiana has been conducted by the Louisiana Geological Survey as part of the geopressured-geothermal test well program sponsored by the U.S. Department of Energy. The primary objectives of this program were: (1) to document the ambient or background microseismic activity in Southwest Louisiana and to determine its causes (e.g. natural processes, geophysical blasting, teleseisms etc.); (2) to assess microseismic activity associated with the high volume fluid production and disposal necessary for commercial

utilization of geopressured-geothermal brines; (3) to monitor long term effects generated by subsurface stresses which may lag behind fluid production.

A summary and review of the microseismic monitoring program from its inception to approximately February 1982 was given. This report was subdivided into four major parts: (1) The various processes, both natural and man-made, which produce seismic activity in Southwest Louisiana; (2) The capacity of the current monitoring network to detect microseismicity and determine its origin (i.e. natural or man-made); (3) A discussion of current results for each region; and (4) the future potential of the network, as well as the seismic data already recorded.

TITLE: ***Numerical Simulation the Pleasant Bayou Geopressured/Geothermal***

AUTHORS: Shook, Mike
PUBLISHER: Idaho National Engineering Laboratory
PAGINATION: 4
PUBLICATION DATE: not given
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Reservoir description and Performance prediction

SCOPE:

The purpose of this report is to demonstrate the use of a commercially available reservoir simulator in evaluating the Pleasant Bayou geopressured-geothermal resource. By incorporating realistic reservoir geometry and heterogeneity, and appropriate petrophysical and fluid properties, a reasonable model of the reservoir can be developed. The development of such a model is extremely underconstrained, and thus a unique reservoir description cannot be formulated. However, a properly developed reservoir model can also be used to constrain possible reservoir properties, and reduce the uncertainty in the model itself. This is among the most important uses of a numerical simulator.

TITLE: ***Parcperdue Geopressured-Geothermal Project Dow-DOE L.R. Sweezy No.1***
SUBTITLE: ***Final Report January 15,1984***

AUTHORS: Coble, L. E., D. Gurley, J. R. Hamilton, J. L. Henley, M. Holland, D.F. Keeley, G.L. Kinsland, J.R. Meriwether, J. Rodgers, R. Smith, J.G. Stanley, and R.Q. Storm
PAGINATION: 433

TITLE: ***Parcperdue Geopressure-Geothermal Project***
SUBTITLE: ***DOW-DOE No. 1 L.R. Sweezy Appendix B Reservoir Testing and Analysis Otis Engineering Corporation***

AUTHOR: DOW-DOE
PAGINATION: 164

TITLE: ***Parcperdue Geopressure-Geothermal Project***
SUBTITLE: ***Dow-DOE No.1 L.R. Sweezy Appendix E: Rock Mechanics-Terratek Reports***
AUTHORS: Sinha,K.P., M.T. Holland, T.F. Borschel and F.J. Schatz
PAGINATION: 288

TITLE: ***Parcperdue Geopressure-Geothermal Project***
SUBTITLE: ***Dow-DOE No. 1 L.R. Sweezy Appendices***

AUTHORS: S-Cubed, Dow Chemical Co., Great Lakes Engineering, George May & Assoc., Dowell, Geochem Laboratories Inc., Weatherly Labs, Completion Technology Inc., University of Southwestern Louisiana
PAGINATION: 250
PUBLISHER: DOW
PUBLICATION DATE: January 1984
SPONSOR: DOW-DOE
REPORT OR CONTRACT#: DE-AC08-79ET27255
DESCRIPTORS: Geology, Petrophysics, Core analysis, Pressure Transient Monitoring, Reservoir testing and analysis, Production testing, Chemical analyses, Put analysis, Drilling, completion, and abandonment, and Environmental considerations

SCOPE:

In 1979, the Dow Chemical Company proposed to investigate the behavior of geopressured reservoirs by drilling an producing a well in small, well defined, geopressured reservoir; and performing detailed pressure transient analysis together with geological, geophysical, chemical, and physical studies.

The Dow-DOE L.R. Sweezy no. 1 well was drilled to a depth of 13,600 feet in Parcperdue field, just south of Lafayette, Louisiana, and began production in April, 1982. The production zone was a poorly consolidated sandstone which constantly produced sand into the well stream, causing

damage to equipment and causing other problems. The amount of sand production was kept manageable by limiting the flow rate to below 10,000 barrels per day.

Reservoir properties of size, thickness, depth, temperature, pressure, salinity, porosity, and permeability were close to predicted values. The reservoir brine was undersaturated with respect to gas, containing approximately 20 standard cubic feet of gas per barrel of brine. Shale dewatering either did not occur of was insignificant as a drive mechanism.

Three significant, unaticipated phenomena were observed:

1. Pressure transient analysis of drawdown and buildup data yielded inconsistent results. Additional rock mechanics studies and reservoir analyses indicated that formation compressibility was much higher than expected, and was higher in drawdown than in buildup. The high compressibility of the reservoir increases the expected ultimate recovery several times.

2. Aromatic hydrocarbons: benzene, toluene, ethylbenzene, and xylenes were detected in and condensed from the gas stream, possibly indicating past or present contact with a liquid petroleum, or petroleum-rich gas phase.

3. Heavy paraffinic oil was produce in small quantities late in the history of the well. The source of the oil production is uncertain.

Production terminated when the gravel-pack completion failed and the production well totally sanded in, February, 1983. Total production up to the sanding incident was 1.94 million barrells brine and 31.5 million standard cubic feet gas.

TITLE: ***Pleasant Bayou Geopressured-Geothermal Reservoir Analysis-January 1991***
SUBTITLE: ***Topical Report***

AUTHORS: Riney, T. D.
PUBLISHER: S-Cubed
PAGINATION: 42
PUBLICATION DATE: January 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: BEG configuration, Production history, Reservoir properties and wellbore calculations, Analysis of pressure data, and Reservoir simulation model

AUTHOR'S ABSTRACT:

Many sedimentary basins contain formations with pore fluids at pressures higher than hydrostatic value; these formations are called geopressured. The pore pres- sure is generally well in excess of hydrostatic and the fluids are saline, hot, and contain dissolved methane. As part of its program to define the magnitude and recoverability of the geopressured-geothermal energy resource, the U.S. Department of Energy (DOE) has drilled and tested deep wells in geopressured formations in the Texas-Louisiana Gulf Coast region. Geological information for the Pleasant Bayou geopressured re- source in southeast Texas is most extensive among the reservoirs tested. Earlier

testing of the DOE well (Pleasant Bayou Well No. 2) was conducted in several phases during 1979-1983. Long-term testing was resumed in May 1988 and is currently in progress. This report summarizes the pertinent field and laboratory test data available through December 31, 1990. A numerical reservoir simulator is employed as a tool for synthesizing and integrating the geological information, formation rock and fluid properties data from laboratory tests, and well data from the earlier testing (1979-1983) and the ongoing long-term production testing (1988-1990) of Pleasant Bayou Well No. 9. A reservoir simulation model has been constructed which provides a detailed match to the well test history to date. The model is constructed within a geologic framework described by the Texas Bureau of Economic Geology and relies heavily on the pressure transient data from the 1980 Reservoir Limits Test in conjunction with the 1988-1990 production testing.

TITLE: ***Pleasant Bayou Geopressured/Geothermal Testing Project Brazoria County, Texas***
SUBTITLE: ***Final Report***

AUTHORS: not given
PUBLISHER: Fenix & Scisson, Inc.
PAGINATION: 176
PUBLICATION DATE: July 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-84NV10322
DESCRIPTORS: Phase II-B testing, Recovery of parted tubing, Tubing failure, Downhole corrosion, and Recompletion plans

SCOPE:

This final report discusses the activities for the remainder of the Phase II-B and subsequent project activities from termination of the Phase II-B test through transfer of the program to the Department of Energy's Idaho Operations Office.

TITLE: ***Pleasant Bayou Well Test. 1988-Present***
SUBTITLE: ***Sampling and Analysis Procedures for Gas, Condensate, Brine, and Solids***

AUTHORS: not given
PUBLISHER: Institute of Gas Technology
PAGINATION: 234
PUBLICATION DATE: not given
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Collection, Analysis, Handling, and Storage of samples

SCOPE:

The manual is divided into small written sections containing sample collection procedures, a list of on-site analytical procedures, and the shipping instructions to outside laboratories. Then the more massive analytical procedures follow in each section.

TITLE: ***Position Paper Rock Mechanics Aspects of Geothermal Energy***
SUBTITLE: ***Subsidence***

AUTHORS: Enniss, D.O. and S. W. Butters
PUBLISHER: TerraTek
PAGINATION: 10
PUBLICATION DATE: September 1977
SPONSOR: DOE - Division of Geothermal Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: Subsidence processes and Subsidence models

SCOPE:

This report defines the physical process of subsidence, other subsidence processes, and subsidence models. This report also suggest laboratory testing to help define critical parameters and establish empirical relationships.

TITLE: ***Procedures Manual For Geopressured Fluids***

AUTHORS: Hankins, B.E. -- **EDITOR**
PUBLISHER: McNeese State University
PAGINATION: 48
PUBLICATION DATE: September 1980
SPONSOR: DOE and Gas Research Institute
REPORT OR CONTRACT#: GRI 5080-321-0301
DESCRIPTORS: Collection of samples, Gas/Water Ratio Data, Treatment of water samples, Special reagents, and Scale and corrosion inhibitors

SCOPE:

This manual was produced in conjunction with a committee formed by the Department of Energy for the expressed purpose of writing a set of standards to be used for sampling and analyzing geopressured fluids. Each procedure is the result of a consensus of the committee.

TITLE: ***Proceedings of the Geothermal Program Review II***
SUBTITLE: ***Oct 11-13, 1983***

AUTHORS: not given
PUBLISHER: DOE Assistant Secretary, Conservation and Renewable Energy Division of Geothermal & Hydropower Technologies
PAGINATION: 443
PUBLICATION DATE: October 1983
SPONSOR: DOE Assistant Secretary, Conservation and Renewable Energy Division of Geothermal & Hydropower Technologies
REPORT OR CONTRACT#: CONF-8310177
DESCRIPTORS: N/A

SCOPE:

The Geothermal and Hydropower Technologies Division held Geothermal Program Review II in October 1983. The intent of the Geothermal Division was to draw experts from DOE field offices, national labs, and industry, chosen for depth and breadth of interest, to help develop a meaningful and substantive program plan. The focus was on the following R&D areas: Hot Dry Rock, Reservoir Programs, Geopressured, and Component and Drilling Research. The purposes of the review were to provide DOE staff with an up-to-date status of geothermal R&D programs, to explore new R&D thrusts of significance to the geothermal industry, and to provide an opportunity for information and technology transfer.

TITLE: ***Proceedings***
SUBTITLE: ***Geothermal Program Review V***

AUTHORS: not given
PUBLISHER: Meridian Corporation
PAGINATION: 254
PUBLICATION DATE: April 1987
SPONSOR: DOE-Assistant Secretary, Conservation and Renewable Energy Geothermal Technical Division
REPORT OR CONTRACT#: CONF-8704110

DESCRIPTORS: N/A

SCOPE:

The Department of Energy's Geothermal Technology Division (GTD) held its Program Review V in Washington, D.C. in 1987. This year attention was directed toward a comprehensive overview of GTD's research and development program with presentations on each major program element by representatives of the operations offices, the national laboratories, contractors and by Headquarters personnel.

The Geothermal R&D Program is implemented by four organizations: GTD Headquarters having overall management responsibility and San Francisco, Idaho, and Albuquerque operations offices carrying out the R&D tasks and projects through the national laboratories and contractors. Thus, Program Review V was presented in four sessions, each chaired by one of the four lead organizations. Appropriately the presentations within each session were related to the program responsibilities and R&D elements which fall under the purview of each of the four organizations. In doing so, Program Review V addressed each of the major geothermal R&D initiatives and programs, and formed a comprehensive overview of the Geothermal R&D Program.

The annual program review meetings are an important element of our efforts to develop, refine and expand the technology base through which the nation's vast geothermal resources can be technically and economically utilized. These meetings provide a forum through which conference participants can obtain an up-to-date report on DOE's geothermal R&D programs and can explore significant new R&D thrusts. The annual Program Review meeting also provides an invaluable opportunity to compare and exchange information with co-workers and interested participants, thus facilitating the transfer of technology among federal, state, and local governments, and industry organizations.

TITLE: ***Geothermal Program Review VIII***
SUBTITLE: ***Proceedings April 18-20, 1990***

AUTHORS: Mock, John E. **---Chairman**
PUBLISHER: Meridian Corporation
PAGINATION: 207
PUBLICATION DATE: April 1990
SPONSOR: DOE Assistant Secretary, Conservation and Renewable Energy Geothermal Division
REPORT OR CONTRACT#: CONF-9004131
DESCRIPTORS: N/A

SCOPE:

Each year the Geothermal Division of the U.S. Department of Energy conducts an in depth review of its entire geothermal R&D program. The conference serves several purposes: a status report on current R&D activities, an assessment of progress and problems, a review of management issues, and a technology transfer opportunity between DOE and the U.S. geothermal industry.

This year's conference, Program Review VIII, was held in San Francisco on April 18 - 20, 1990.

The theme of this review was 'The National Energy Strategy -- The Role of Geothermal Technology Development." The Administration is developing the National Energy Strategy to define the Nation's approach for a reliable, economic and environmentally safe energy supply. The ultimate contribution of geothermal energy to the NES hinges upon expanding the U.S. geothermal reserves. Only by improving the economic and technological viability of geothermal energy can the exploitable geothermal reserves increase sufficiently to fulfill the potential role of geothermal energy in the Nation's energy supply.

Program Review VIII was composed of seven sessions including an opening session with presentations by Mr. Stephen Lipman, President, UNOCAL Geothermal Division, and Mr. Michael Fleys, President, California Energy Company. The five technical sessions included presentations by the relevant field researchers covering DOE-sponsored R&D in hydrothermal, hot dry rock, geopressured, and magma energy.

As with previous Program Reviews, a key facet of PR VIII was an "Industry Critique" session organized and chaired by the National Geothermal Association (NGA). This year, five NGA representatives were asked to comment on specific areas of DOE's geothermal R&D: Drilling and Completion, Exploration, Power Conversion, Reservoirs, and Fluid Handling. The comments provided valuable insight into near- term industry concerns and needs and reinforced the basic thrust of the DOE program.

TITLE: ***Proceedings First Geopressured Geothermal Energy Conference***

AUTHORS: Dorfman, M.H. and Richard W. Deller--**EDITOR**
PUBLISHER: Center for Energy Studies
PAGINATION: 369
PUBLICATION DATE: June 1975
SPONSOR: The Center for Energy Studies, The Bureau of Economic Geology, and The College of Engineering--The University of Texas at Austin and The United States Energy Research and Development Administration
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

With the increasing demand for energy and the decreasing supply of traditional fuels, research on alternate energy sources has been assigned a new emphasis and urgency. One such alternate energy form, geothermal energy, has the potential to supply large quantities of electrical and thermal energy. Many conferences and papers have described and discussed the steam and hydrothermal systems that have already experienced commercial development. Another type of geothermal resource is now being considered for development: the geopressured geothermal reservoirs, which have large energy potentials. The purpose of the First Geopressured Geothermal Energy Conference was to describe the geological system, the reservoir engineering aspects, the surface technology, and the institutional, legal, and environmental problems that must be studied, and to disseminate currently available information to interested parties.

The Proceedings of the First Geopressured Geothermal Energy Conference are presented as a complete record of the conference activities. The invited papers and the discussions between the authors and participants are presented. A discussion period followed most papers and an open discussion followed each session; the proceedings present these discussions in the same manner.

TITLE: ***Proceedings Fourth United States Gulf Coast Geopressured-Geothermal Energy Conference: Research and Development Volume 1, 2, 3***
SUBTITLE: ***October 1979***

AUTHORS: Dorfman, Myron H. and William L Fisher -- **EDITORS**
PUBLISHER: Center for Energy Studies The University of Texas at Austin
PAGINATION: 1692
PUBLICATION DATE: June 1980
SPONSOR: Center for Energy Studies, Bureau of Economic Geology in cooperation with Continuing Engineering Studies, College of Engineering --The University of Texas at Austin and United States Department of Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

The Fourth United States Geopressured Geothermal Energy Conference was held at The University of Texas on October 29-31, 1979. The conference represents one in a series of conferences on this potential energy source that began at this university in 1975. These proceedings represent the results of continuation of research that began more than six years ago and is now moving from basic to applied field studies. We have attempted to cover the subject in all of its many aspects: geological, geophysical, engineering, legal, and institutional.

Included in the conference proceedings are not only the papers presented by various researchers, but also a portion of the interaction that occurred in discussion, as recorded at the time. We feel that such interaction is one of the important benefits of these meetings, which bring together government, industry, and academia in quest of a common goal: dissemination of knowledge to determine as quickly as possible the ultimate resolution of the questions concerning the viability of this potential resource. Not to be overlooked are the basic research topics that will have benefits to those exploring for conventional hydrocarbon deposits in the Northern Gulf of Mexico basin, and perhaps in similar basins worldwide.

TITLE: ***Proceedings***
SUBTITLE: ***Third Geopressured Geothermal Energy Conference Volume 1 and 2***

AUTHORS: Meriwether, John -- **EDITOR**

PUBLISHER: University of Southwestern Louisiana
PAGINATION: Vol. I- 594; Vol. II-628
PUBLICATION DATE: November 1977
SPONSOR: Doe and American Gas Association
REPORT OR CONTRACT#: EG-77-G-05-5557
DESCRIPTORS: N/A

SCOPE:

The Third Geopressured-Geothermal Energy Conference was held at the University of Southwestern Louisiana November 16-18, 1977.

This Conference was designed to look at the Geopressured-Geothermal Resource in all its aspects: geological, legal, engineering, environmental, and economic. This was accomplished by formal presentations and the interaction of people concerned with these diverse aspects. The attendees came from industry, government and universities and brought their own unique viewpoints and perspectives to bear on the questions at hand. The Conference was a success if a cross fertilization of all these aspects occurred.

These Proceedings are a record of the formal presentation at the various sessions of the Conference.

TITLE: ***Proceedings Fifth Conference Geopressured-Geothermal Energy***

AUTHORS: Babbitt, Don G. and Ann L. Bachman-- **EDITORS**
PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 343
PUBLICATION DATE: 1981
SPONSOR: Louisiana Geological Survey Louisiana State University and DOE
REPORT OR CONTRACT#:not given
DESCRIPTORS: N/A

SCOPE:

The Fifth Conference on Geopressured-Geothermal Energy, held at Louisiana State University on October 13 to 15, 1981, represents a cooperative effort by the many researchers and organizations who have conducted studies on this potential energy resource. The Conference was sponsored by the U.S. Department of Energy, the Energy Programs Office of Louisiana State University, and the Louisiana Geological Survey to bring together those interested in developing this resource.

The Fifth Conference focuses on the results of test wells with additional sessions on support studies. The DOE program to determine the magnitude and economic potential of the resource is well-advanced. Research on the geology, reservoir engineering, process technology, and geochemistry of methane in solution in the offshore areas of Texas and Louisiana has been underway for six years. Environmental, economic, and legal concerns have also received considerable attention. The period since the Fourth Conference in 1979 has been particularly

productive. The first geopressured design well, the Pleasant Bayou No. 2, has undergone several stages of testing, and three additional design wells have been drilled. In the DOE Wells-of-Opportunity Program, nine wells have been reentered and produced since 1979. These short-term tests as well as associated studies, such as research on controls on methane content and salinity determination from logs, have provided additional valuable information.

TITLE: ***Proceedings of the Sixth US Gulf Coast Geopressured-Geothermal Energy Conference***

AUTHORS: Dorfman, Myron H. and Robert A. Morton ---**EDITORS**
PUBLISHER: Pergamon Press
PAGINATION: 344
PUBLICATION DATE: 1985
SPONSOR: University of Texas at Austin--Energy Studies, Bureau of Economic Geology, College of Engineering and DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

The United States Geopressured-Geothermal Conference, held at The University of Texas at Austin on February 4-6, 1985, was the sixth in a series of conferences, beginning in 1975, organized to present the technological advances made toward successful exploitation and utilization of this alternative energy resource. The sixth conference focused on the important results of field tests and related research that had accumulated since the previous conference in 1981.

Session topics of special interest included the production characteristics of design wells, the deformation history of geopressured sediments, the detection of microseismic events, the anomalous occurrences of liquid hydrocarbons in geothermal brines, and the transfer of technology to improve recovery from gas reservoirs. The technical presentations prompted considerable discussion and encouraged the open exchange of information and ideas among the participants representing government, industry, and academia.

TITLE: ***Proceedings: Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource January 10, 1990 , Volume 1,2***

AUTHORS: Negus-de Wys, J.--**EDITOR**
PUBLISHER: EG&G Idaho, Inc. Idaho National Engineering Lab
PAGINATION: 265
PUBLICATION DATE: January 1990
SPONSOR: E&G&G Idaho, Inc. Idaho National Engineering Lab
REPORT OR CONTRACT#: not given

DESCRIPTORS: N/A

SCOPE:

The Geopressured-Geothermal Program, now in its fifteenth year, is entering the transition period to commercial use. The industry cost-shared proposals to the consortium, represented in the presentations included in these proceedings, attest to the interest developing in the industrial community in utilizing the geopressured-geothermal resource.

Sixty-five participants attended these sessions, two-thirds of whom represented industry. The areas represented by cost-shared proposals include 1) thermal enhanced oil recovery, 2) direct process use of thermal energy, e.g., aquaculture and agriculture, 3) conversion of thermal energy to electricity, 4) environment related technologies, e.g., use of supercritical processes, and 5) operational proposals, e.g., a field manual for scale inhibitors.

TITLE: ***Proceedings Vol. I & Vol. II Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource***

AUTHORS: Neugus-De Wys, Jane-**EDITOR**
PUBLISHER: EG&G Idaho, Inc. and Idaho National Engineering Lab
PAGINATION: 361
PUBLICATION DATE: February 1991
SPONSOR: EG&G Idaho, Inc. and Idaho National Engineering Lab
REPORT OR CONTRACT#: CONF-9009333
DESCRIPTORS: N/A

SCOPE:

The purpose of the Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource is to provide technology transfer to industry, to provide a forum for teaming of industrial components, and to provide an avenue by which selected industry cost-shared proposals can be viewed by state and federal agencies as potential programmatic pilot development.

The proceedings from the September 11, 1990, meeting at the University of Texas at Austin include some of the latest ideas and data on utilization of the geopressured-geothermal resource. The mailing list in the back of Volume 2 is the most current listing of interested and contributing participants.

TITLE: ***Project Report of 1st order Leveling Phase II at Pleasant Bayou Geopressured-Geothermal Test Site Brazoria County, Texas***

AUTHORS: Vernon F. Meyer and Associates, Inc.
PUBLISHER: Vernon F. Meyer and Associates, Inc.
PAGINATION: 110
PUBLICATION DATE: October 1988
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: Locality, Conditions, Organization, and Field work

SCOPE:

The purpose of this report is to document the First Order, Class I, leveling that was conducted to monitor subsidence of previously installed and leveled bench marks, established by the National Geodetic Survey (NGS) and Vernon F. Meyer and Associates, Inc., in the area of the Pleasant Bayou geopressured test well. All leveling surveys to conform to NGS standards and specifications.

TITLE: ***Project Report of 1st Order Leveling Phase II at Pleasant Bayou Geopressured-Geothermal Test Site Brazoria County, Texas 1990***

AUTHORS: Vernon F. Meyer & Associates, Inc.
PUBLISHER: Vernon F. Meyer & Associates, Inc.
PAGINATION: 111
PUBLICATION DATE: November 1990
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: Location, Conditions, Organization, and Field work

SCOPE:

The purpose of this report is to document first order leveling surveys that were conducted as part of an ongoing environmental monitoring program for geopressured geothermal test wells. First Order, Class I, leveling was conducted to monitor subsidence of previously installed and leveled bench marks, established by the National Geodetic Survey (NGS) and Vernon F. Meyer and Associates, Inc., in the area of the Pleasant Bayou geopressured test well. All leveling surveys to conform to NGS standards and specifications.

TITLE: ***Project Report***
SUBTITLE: ***Releveling: Parcperdue Geopressure Test Site May 1983***

AUTHORS: Vernon F. Meyer and Associates, Inc.

PUBLISHER: Vernon F. Meyer and Associates, Inc.
PAGINATION: 100
PUBLICATION DATE: May 1983
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: Location and Conditions

SCOPE:

This report documents the first Order leveling surveys that were to be conducted as part of an environmental monitoring program for geopressured test well. First order leveling was conducted to determine the elevation of the previously installed and leveled Bench marks in the area of the Parcperdue geothermal well. All leveling surveys to conform to NGS standards and specifications.

TITLE: ***Project Report***
SUBTITLE: ***Releveling: Parcperpdue Geopressure Test Suite Phase 2 April 1984***

AUTHORS: Vernon F. Meyer and Associates, Inc.
PUBLISHER: Vernon F. Meyer and Associates, Inc.
PAGINATION: 214
PUBLICATION DATE: April 1984
SPONSOR: Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: Location, Conditions, Organization, and Field work

SCOPE:

The purpose of this report is to document the first Order leveling surveys that were conducted as part of an environmental monitoring program for geopressured test well. First order leveling was conducted to determine the elevation of the previously installed and leveled bench marks in the area of the Parcperdue geothermal well. All leveling surveys to conform to NGS standards and specifications.

TITLE: ***Pleasant Bayou Operations Brazoria County, Texas***

AUTHORS: Eaton, B. A., C. R. Featherston, and T. E. Meahl
PUBLISHER: not given

PAGINATION: 2
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Hybrid power systems (HPS), Production, and Controlling factors

AUTHOR'S ABSTRACT:

This project will demonstrate the Hybrid Cycle Concept for electricity generation using geopressured -geothermal resources. The test is scheduled to be a minimum of one year, which may be extended. The majority of the equipment came from the DOE facility at East Mesa, CA. The hybrid cycle has been designed for 10,000 BPD brine and 220,000 SCFD of gas. The power output will be about one megawatt, which will be sold to Houston Lighting and Power Company.

An important research objective is to determine the size and ultimate production capability of the geopressured-geothermal reservoir. The long-term deliverability of these type reservoirs is a significant factor in determining the ultimate economic capability of these systems.

Some of the significant controlling factors of this project are:

1. Pressure, deliverability, and long-term life of the reservoir.
2. Injection pressures and volumes of the disposal well.
3. Turbine life.
4. Scaling and corrosion.

TITLE: ***Possible Use of Geopressured Aquifers for the Short-Term Storage of Energy***
SUBTITLE: ***A Thesis***

AUTHORS: Elemo, Rufus Oladipo
PUBLISHER: Louisiana State University Department of Petroleum Engineering
PAGINATION: 52
PUBLICATION DATE: May 1976
SPONSOR: Louisiana State University Department of Petroleum Engineering
REPORT OR CONTRACT#: not given
DESCRIPTORS: Energy recovery efficiency, Flow rate, and Bottom-hole wellbore pressure

SCOPE:

This study was made to investigate the technical feasibility of utilizing subsurface geopressured aquifers to store energy for short periods of time. A prime application of this short term energy storage would be in peak-shaving by electrical generating companies. Peak-shaving is defined as the storage of energy during times of low energy demand for later use during times of high energy demand. The idea investigated in this thesis is the utilization of excess electrical energy to inject water at high pressure into the geopressured aquifer. The recovery of the energy would involve the production of the high pressure water from the aquifer and using it to power some type of surface

conversion unit, such as an electricity generating turbine. To describe the process, two computer programs were written, one for the case in which there is a single well in a closed aquifer, and the other for the case of multi-well system in a closed aquifer.

The term Energy Recovery Efficiency (ERE), as developed in this thesis, is defined as the ratio of the energy recovered from the high pressure water when it is produced on the surface to the energy used to inject the water into the aquifer. The effect of several pertinent variables in the process on the value of ERE was investigated. As a result of this study, it was found that some of the more important variables are aquifer permeability, sand thickness and flow rate. Aquifer size was found to be relatively unimportant. Multi-well and single well systems behaved virtually the same.

TITLE: ***Prediction of Maximum Flow Rates From Geopressured Aquifers***
SUBTITLE: ***A Thesis***

AUTHORS: McMullan, John Hughes
PUBLISHER: Louisiana State University Department of Petroleum Engineering
PAGINATION: 50
PUBLICATION DATE: August 1979
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Recoverable energy, Production rate, and Geopressured aquifer

SCOPE:

Geopressured aquifers are believed to contain large amounts of recoverable energy in the form of dissolved gas and heat. In order to evaluate the economic feasibility of producing geopressured aquifers for their energy content, numerous investigators have used conventional petroleum engineering techniques to predict the time required for the surface pressure to reach some limiting value for a constant production rate. This study developed a method to predict the production rate resulting from a geopressured aquifer if the surface pressure is maintained at some constant, minimal value. Such a production rate is the maximum possible and would accelerate the recovery of the energy and thereby increase its present value.

The developed technique was incorporated into two computer programs. The first program predicts the rate from an infinite acting geopressured aquifer. For this case, the constantly changing flow rate is approximated in a stair-step fashion using the unsteady-state solution to the diffusivity equation and the principle of superposition to change the rate. The second computer program adds the effects of aquifer boundaries by using image wells to create a rectangular shaped aquifer with the well located at any position within the aquifer.

The developed technique was applied to the Southeast Pecan Island and LaFourche Crossing geopressured aquifers. A sensitivity analysis of the Southeast Pecan Island aquifer indicates that production rates are most sensitive to changes in aquifer size, compressibility, and initial pressure. For the high flow rates encountered in geopressured aquifer production, the production rate is also strongly influenced by tubing size and formation damage. For reasonable changes in the other

parameters, the production rate is not substantially affected.

TITLE: ***Rates of Return For Producing Methane From Geopressured Aquifers***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 21
PUBLICATION DATE: 1979
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Thermal energy and Hydrokinetic energy

SCOPE:

Two geopressured aquifer studies prepared in 1978 suggested that production of methane from geopressured aquifers might be economic under certain circumstances. However, the studies imputed no value to the thermal and hydrokinetic energy content of the geopressured brine. Internal rates of return calculated using a corporate analytic approach suggest that marginal to attractive returns on investment are available and that secondary energy credits (particularly hydrokinetic) may improve the returns, especially at higher wellhead reinjection pressures.

TITLE: ***Recommendation to Drill, Test, and Evaluate a Geopressured-Geothermal Resource Test Well in Cameron Parish, Louisiana***
SUBTITLE: ***A Geopressured-Geothermal Resource Test Well***

AUTHORS: not given
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 85
PUBLICATION DATE: September 1979
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-77ET28460
DESCRIPTORS: Geopressured-Geothermal prospect, Sit and surface facilities, Drilling operations, Production testing, Reservoir analysis, Plug and abandonment operations, Occupational health and safety, and Environmental considerations

SCOPE:

This report is a recommendation to drill a demonstration well in order to test and evaluate the geopressured-geothermal (Geo2) resource at a proven site in the Geo2 fairway of South Louisiana. The location is in Section 27, T15S, R5W, Cameron Parish, Louisiana, adjacent to the Getty Oil Company-Buttes Gas and Oil Company No. 1 Gladys McCall. This well was approved by the Department of Energy (DOE) for testing after Gruy Federal's (Gruy's) selection of it as a candidate for testing by re-entry into the abandoned hole. The well was re-permitted as the Gruy DOE No. 1 Gladys McCall. The test was unsuccessful for mechanical reasons, but the location within the geothermal fairway of South Louisiana remains a prime candidate in the national geothermal program. This report is a recommendation to drill a new geopressured-geothermal test well for more comprehensive testing, sampling, and evaluation at approximately the same location.

TITLE: ***Renewable Energy Resources of the World***
SUBTITLE: ***Ideas and Technology***

AUTHORS: not given
PUBLISHER: Strategies Unlimited
PAGINATION: 70
PUBLICATION DATE: not given
SPONSOR: California Energy Commission
REPORT OR CONTRACT#: 500-85-022
DESCRIPTORS: Renewable Energy Resources, Solar, Wind, Hydropower, Geothermal, and Biomass

SCOPE:

This document has been prepared as part of the California Energy Commission's Energy Technology Export Program. A principal element of this program is to provide information on international market opportunities for the California renewable energy industry, particularly small and medium-sized businesses. In support of that objective, this document indicates the levels of renewable energy resources in 160 of the world's countries. The resources addressed include solar, wind, geothermal, biomass, and hydro.

The resource data in this document are derived from existing studies and assessments, which are listed in the References section. These data are basically raw resource data, that is, they are estimates of the total unconverted energy content of particular resources in particular countries. In some cases (e.g. solar radiation, wind energy), the appropriate unit of measurement is energy flux per unit area. In other cases (e.g. biomass), the appropriate unit is the total energy made available annually. Finally, in other cases (e.g. geothermal), the appropriate unit is the total energy resource content in situ. For these reasons, energy values for the different resource forms cannot be directly compared with one another.

Resource evaluations such as those shown in this document do not, in themselves, constitute estimates of the total usable energy that could be made available in each country. This can only be provided through detailed economic and technology analysis for each resource type. In general, such

analyses are very country-specific, and are dependent upon the resource conversion economics and energy price situation in each country. However, resource data shown in this report may be used as a general guide to the level of renewable energy resources in each country and can, in conjunction with additional market and economic data, be used as an indicator of where renewable energy resource development can be most feasible.

TITLE: ***Research and Development for the Geopressured-Geothermal Energy Program Volume I. Flow Tests of the Gladys McCall Well***
SUBTITLE: ***Final Report for the Period October 1985-October 1990***

AUTHORS: Randolph, P.L., C. G. Hayden, and L.A. Rogers
PUBLISHER: Institute of Gas Technology
PAGINATION: 491
PUBLICATION DATE: April 1992
SPONSOR: Eaton Operating Company and DOE
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Sand 9 testing, Sand 8 testing, Gas saturation, Brine, Suspended solids, Scale inhibition, and Corrosion

SCOPE:

This report pulls together the data from all of the geopressured-geothermal field research conducted at the Gladys McCall well. It includes testing performed by the prior prime contractor, Technadril-Fenix & Scisson, as well as work performed while the prime contractor was Eaton Operating Company (EOC) with the Institute of Gas Technology (IT) as a subcontractor.

TITLE: ***Volume II. Testing of the Pleasant Bayou Well Through October 1990***
SUBTITLE: ***Final Report for the Period October 1985-October 1990***

AUTHORS: Randolph, P.L., C.G. Hayden, V.L. Mosca, and J. L. Anahaiser
PUBLISHER: Institute of Gas Technology
PAGINATION: 489
PUBLICATION DATE: August 1992
SPONSOR: Eaton Operating Company
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Rehabilitation of the Pleasant Bayou Well, Production data, Brine sampling and analysis, Hydrocarbon sampling and analysis, Solids sampling and analysis, Scale control, and Corrosion monitoring and control

SCOPE:

This report focuses on the data obtained from the well-test program subsequent to rework of the production well by Eaton Operating Company in 1986. The intent is to provide detailed data on the physical and chemical processes involved in producing energy from the Pleasant Bayou well and to provide information that may be useful for future production from wells with a high water cut, including other geopressured-geothermal wells

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TITLE: ***Research and Development for the Geopressured-Geothermal Energy Program Volume III. Flow Tests of the Willis Hulin Well***
SUBTITLE: ***Final Report for the Period October 1985-October 1990***

AUTHORS: Randolph, P.L., C.G. Hayden, and L.A Rogers
PUBLISHER: Institute of Gas Technology
PAGINATION: 101
PUBLICATION DATE: February 1992
SPONSOR: DOE and Eaton Operating Company
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Bottomhole pressures, Brine compositions, and Gas compositions

SCOPE:

The Willis Hulin well, located in Vermilion Parish, Louisiana, is the deepest, hottest, and highest pressured well to be tested in the U.S. Department of Energy's Geopressured-Geothermal Program. The interval of interest for testing in the Hulin well is the massive aquifer sand between 20,100 and 20,700 feet. This geologic section is comprised mostly of layers of brine-saturated, clean sand with occasional intervening layers or lenses of shale. The objective of the test was to determine the characteristics of the brine and gas in this interval and to make an initial determination of the reservoir properties.

TITLE: ***Research and Development Program Plan for Geopressure-Geothermal Resources***

AUTHORS: not given
PUBLISHER: DOE--Division of Geothermal Energy Assistant Secretary for Resource Applications Department of Energy
PAGINATION: 55
PUBLICATION DATE: December 1980
SPONSOR: DOE
REPORT OR CONTRACT#: not given

DESCRIPTORS: Geopressure-Geothermal resource, Federal role, Technical program, Environmental studies, Management plan, and Funding requirements

SCOPE:

This document presents the Department of Energy's Research and Development Program Plan for Geopressure-Geothermal Resources for FY81 through FY86. The Plan provides and overall perspective for these energy sources and describes the Department of Energy's R&D program directed toward resolving the geologic, technical, and economic barriers that currently impede their development. The topics covered in the Program Plan include:

1. The program goals, objectives, and strategy;
2. The status of resource definition, research and technology development including the program milestones;
3. The supporting environmental activities;
4. The management plan for the program;
5. The financial resource requirements.

TITLE: ***Research and Development for the Geopressured-Geothermal Energy Program Flow Tests of the Gladys McCall Well***
SUBTITLE: ***Final Report for the Period October 1990- February 1993***

AUTHORS: Randolph, P. L., J. L. Anhaiser, and C. G. Hayden
PUBLISHER: Institute of Gas Technology
PAGINATION: 116
PUBLICATION DATE: July 1993
SPONSOR: Eaton Operating Company and DOE
REPORT OR CONTRACT#: DE-AC07-92ID12944
DESCRIPTORS: Production facilities, Flow testing, Pressure buildup data, Chemistry, and Scale and norm

SCOPE:

This report covers the pressure draw-down/buildup test performed in October 1991 as part of the continuing geopressured-geothermal field research conducted at the Gladys McCall well for the U.S. Department of Energy (DOE). It includes wellhead pressure data and investigations of naturally occurring radioactive material (NORM) that continued into 1992. Eaton Operating Company (EOC) was the prime contractor with the Institute of Gas Technology (IT) as a subcontractor.

TITLE: ***Reservoir Study of Lafourche Crossing Geopressured Water Sands and Test Well Site Selection***

AUTHORS: Bassiouni, Dr. Zaki
PUBLISHER: Department of Petroleum Engineering Louisiana State University
PAGINATION: 43
PUBLICATION DATE: October 1978
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Aquifer temperature, pressure, salinity, porosity, permeability, Dissolved natural gas content, and Salt water disposal well

AUTHOR'S ABSTRACT:

The detailed technical evaluation of the geopressure aquifer prospect is described The quantitative evaluation was based on detailed geology consisting of structural, isophachous, and cross-sectional maps of the geopressured zone. Pressure, water salinity, porosity, and permeability data were obtained from well logs. The gathered information was used to choose a location for a proposed exploratory well.

TITLE: ***Reservoir Analysis Gladys McCall No.1***

AUTHORS: not given
PUBLISHER: Dowdle Fairchild & Ancell, Inc.
PAGINATION: 31
PUBLICATION DATE: May 1984
SPONSOR: Technadril
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geological setting, Simulator, and Reservoir

SCOPE:

The Technadril-Fenix & Scisson Gladys McCall No. 1 was drilled in Cameron Parish, Louisiana, as part of the Geopressured-Geothermal Program sponsored by the U.S. Department of Energy. The overall purpose of the well is to determine and demonstrate through long term flow testing the technological and economic feasibility of recovery of methane and thermal energy associated with geopressured-geothermal fluids. This report uses reservoirs tested and to predict the performance of these reservoirs under various external conditions.

TITLE: ***Results of Long-Term Testing of a Geopressured-Geothermal Design Well T-F&S/DOE***

Gladys McCall No. 1

AUTHORS: Durrett, Larry
PUBLISHER: Technadril-Fenix & Scisson
PAGINATION: 12
PUBLICATION DATE: February 1985
SPONSOR: Technadril-Fenix & Scisson
REPORT OR CONTRACT#: not given
DESCRIPTORS: Brine production, Production well, Reservoir depletion, Gas sales, Two-stage brine/gas separation, Calcium carbonate scaling, and Corrosion/Erosion

AUTHOR'S ABSTRACT:

The first year of the long-term testing phase of the Gladys McCall No. 1 Project was completed in November, 1984. Some six million barrels of brine and 180 million cubic feet of solution natural gas (ca 30 SCF/STB) have been produced from the reservoir associated with the massive sand zone no. 8 (15,158- 15,490), the largest of eleven sand zones in the well. The sand zone no. 8 reservoir pressure has been decreased by a net of about 900 psi during this year.

The well has produced and average of 19,837 B/SD of brine (ca 16,465 B/CD) and about 595,000 SCF/SD of solution natural gas, and has been on production about 83% of the time during this year of testing.

A 2.4 mile gas gathering pipeline (3-1/2 inch O.D.) was laid to connect into a major gas transmission pipeline in the area, a glycol dehydration unit was installed, and the sale of solution natural gas from the Gladys McCall No.1 well began in May, 1984.

Extensive test runs using two-stage brine/gas separation demonstrated that gas recovery could be improved from about 23 SCF/STB to about 27.5 SCF/STB (i.e., a gas recovery improvement from about 77% to 92%) using this process, and a permanent second-stage separator was installed in July, 1984. A small compressor was installed on the second-stage separator gas production line in October, 1984 to boost the pressure of this gas to about 1,100 psi, and permit delivery and sale of second-stage gas.

Major problems areas have been the formation of calcium carbonate scale in the 5-inch production tubing string which limits the brine production rate, and, to a lesser degree, corrosion/erosion in some of the surface equipment. It has been demonstrated that scale lin the downhole tubulars can be removed very effectively using 15% hydrochloric acid. An aborted and unsuccessful attempt at a downhole scaling inhibitor adsorption/precipitation squeeze, which was made in November, 1984, is discussed.

TITLE: Revised Geologic Summary Data for Forecasting Drilling and Reservoir Conditions for The T-F&S/DOE Gladys McCall No. 1 Well

AUTHORS: not given
PUBLISHER: Technadril-Fenix & Scisson
PAGINATION: 49

PUBLICATION DATE: June 1981
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressure-Geothermal environment, Geopressure-Geothermal structure, and Disposal well parameters

SCOPE:

The purpose of this report is to summarize the known and interpreted geology of the geopressured-geothermal regime of the Technadril-Fenix (T-F&S), Department of Energy (DOE) well, Gladys McCall no. 1.

TITLE: ***Reinjection of Fluids into a Producing Geopressured Reservoir***
SUBTITLE: ***Topical Report***

AUTHORS: Garg, S.K.
PUBLISHER: DOE
PAGINATION: 27
PUBLICATION DATE: October 1979
SPONSOR: DOE
REPORT OR CONTRACT#: AC08-79ET27202
DESCRIPTORS: MUSHRM and Reinjection

AUTHOR'S ABSTRACT:

A reservoir simulator (MUSHRM) was employed to examine the effects of reinjecting the processed brine on the long-term performance of a representative geopressured reservoir. These calculations indicate that reinjection can be used to substantially increase methane and brine production. The results suggest that power requirements for reinjection pumps can be met by either burning approximately two-thirds of the produced methane (This may in some cases negate the benefits of reinjection as far as methane production is concerned.), or by using the heat of the produced brine (320 ^{0}F to generate electric power). Assuming that electric power produced from hot brine is used to reinject the processed fluids, it appears that reinjection is a viable production strategy for increasing methane recovery from some geopressured systems. The attractiveness of reinjection to recover methane increases with increasing formation permeability, and decreasing formation compressibility.

TITLE: ***Reservoir Engineering Studies of the Gladys McCall Geopressured-Geothermal Resource***
SUBTITLE: ***Final Report***

AUTHORS: Lea, Chen-Min, Kunsang Lee and Mark A. Miller
PUBLISHER: Center for Petroleum and Geosystems Engineering University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: September 1993
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Transient pressure analysis and Aquifer influx model

AUTHOR'S ABSTRACT:

Transient pressure analysis techniques have been used to evaluate the performance of the Gladys McCall geopressured-geothermal reservoir. A fault-controlled aquifer influx model has also been developed to account for pressure support observed during both reservoir depletion and recovery phases.

The Gladys McCall No. 1 well was drilled and completed in the lower Miocene geopressured sandstones under the U.S. Department of Energy geopressured-geothermal research program. The well was shut in October 1987 after producing over 27 MMstb of brine and 676 MMscf gas since October 1983. Eight pressure transient tests were conducted in the well. Analysis of transient pressure data provided a quantitative evaluation of reservoir characteristics, including: a) formation transmissibility and skin, b) the size and possible shape of the main producing reservoir, and c) characteristics of the pressure support mechanism.

The pressure behavior of 1983 Reservoir Limits Test (RLT) suggested that the Gladys McCall reservoir might have a long narrow shape with the well located off-center. An elongated numerical model developed accordingly was able to reproduce the pressure characteristics shown in the test. During both the reservoir production and shut-in periods, pressure buildup tests indicated some degree of external pressure support. Aquifer recharging was believed to be the main source. Based on reservoir material- balance calculations, an aquifer influx model was derived from a conceptual model of water leakage through a partially sealing fault into the reservoir under steady-state conditions. Moreover, a match of the pressure history required that the conductivity of the fault be a function of the pressure difference between the supporting aquifer and the reservoir.

TITLE: ***Restoration of an Abandoned Gas Well For Geopressured-Geothermal Energy Extraction, Part 1***

AUTHORS: Eaton, B. A., T. E. Meahl, and C. R. Featherson
PUBLISHER: Geothermal Science and Technology Volume 2
PAGINATION: 16
PUBLICATION DATE: 1990
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured-geothermal, Well restoration, and Energy extraction

SCOPE:

As part of the U. S. Department of Energy (DOE) Geopressured-Geothermal Energy Program, the Willis Hulin No. 1 well in Vermilion Parish, Louisiana was restored to operating condition, subjected to a short-term flow test, and prepared for intermediate term (sixty days) flow testing. If this test is successful, the well will be recompleted with larger diameter tubing for a long-term flow test of one year or more. One of the objectives of this "Well of Opportunity" test is to establish the feasibility of reclaiming wells, with no continued or future utilization as hydrocarbon producers, for use as geopressured-geothermal energy producers, thus saving the high cost of drilling new wells. When this well was donated to the Department, it had major mechanical problems and had to be reworked in order to restore it to operating condition. Recompletion was accomplished for about one-fourth the cost of drilling a new well to the same depth, in the same zone. Details of the restoration strategy, rework approach, and future utilization for research and development of methods for extraction of geopressured-geothermal energy are contained in this report. Future reports will describe the results of flow tests and the economic feasibility of energy recovery from such wells.

TITLE: ***Rock Mechanics Test Data For Geopressured-Geothermal Reservoir Rocks***
SUBTITLE: ***December 31, 1991***

AUTHORS: Gray, K. E.
PUBLISHER: Center for Earth Sciences and Engineering Balcones Research Center University of Texas at Austin
PAGINATION: not given
PUBLICATION DATE: December 1991
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Reservoir behavior, Overburden rock behavior, Compaction behavior, Time dependent rock behavior, and Three-dimensional rock properties and behavior

SCOPE:

Summary report of rock mechanics test data conducted by University of Texas at Austin for the Geopressured program. Research was concentrated on the Gladys McCall well in Louisiana. Objectives of the research were to review previous work and to define rock properties to better classify geopressured reservoirs.

TITLE: ***Releveling: Sweetlake Geopressured Test Site***

AUTHORS: not given

PUBLISHER: Vernon F. Meyer and Associates, Inc.
PAGINATION: 98
PUBLICATION DATE: July 1984
SPONSOR: Louisiana State University and DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Location, Conditions affecting process, Organization, and Field work

SCOPE:

This report documents the first order leveling surveys that were conducted as part of an environmental monitoring program for geopressured test well. The first order leveling was conducted to determine the elevation of the previously installed and leveled bench marks in the area of the Sweetlake geothermal well. All leveling surveys conformed to NGS standards and specifications.

TITLE: ***Saline Fluid Flow and Hydrocarbon Migration and Maturation as Related to Geopressure, Frio Formation, Brazoria County, Texas***

AUTHORS: Tyler, Noel, M. P. R. Light, and T.E. Ewing
PUBLISHER: not given
PAGINATION: 11
PUBLICATION DATE: 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-79ET27111
DESCRIPTORS: Thermal-maturity profiles, Basinal fluid flow, and Isotope ratios

AUTHOR'S ABSTRACT:

The Pleasant Bayou geopressured-geothermal test wells in Brazoria County Texas display a prominent thermal-maturity anomaly in the Oligocene Anahuac and Frio Formations. Highly geopressured more mature shales are interbedded with hydropressured to moderately geopressured sandstones in the upper Frio ad Anahuac. In contrast shales and sandstones in the lower Frio including the Anahuac geopressured-geothermal production zone are highly geopressured but exhibit lower thermal maturities.

Vitrinite-reflectance data, supported by hydrocarbon-maturation data and anomalous concentrations of C5 to C7 hydrocarbons at Pleasant Bayou, indicate that the upper Frio was subjected to an extended period of hot, extremely saline, basinal fluid flow which caused the above thermal anomaly. Regional salinity studies (Morton and others, 1983) suggest that regional growth faults were the conduits for vertical basinal brine movement at depth. At shallower levels the upwelling waters migrated laterally through permeable sandstone-rich sections such as the upper Frio. Anomalously mature gasoline-range (C5-C7) hydrocarbons were introduced into the upper Frio by this process. Fluid influx in the lower Frio was probably limited by high geopressure,

consequently maturity in the deep Frio section (greater than 14,000 ft) remained consistent with the regional geothermal gradient.

TITLE: ***Sampling and Analysis Methods for Geothermal Fluids and Gases***

AUTHORS: Watson, J.C.
PUBLISHER: Pacific Northwest Laboratory
PAGINATION: 225
PUBLICATION DATE: July 1978
SPONSOR: DOE
REPORT OR CONTRACT #: EY-76-C-061830
DESCRIPTORS: Geothermal tasks, Chemical analyses, Sampling procedures, and Analytical methods

SCOPE:

This manual is the third document issued in the process of formulating a manual of sampling and analysis methods for geothermal fluids and gases. This document is the result of efforts begun in 1975 to assemble a manual of recommended methods of sampling and analysis.

TITLE: ***Screening of Three Proposed Doe Geopressured-geothermal Aquifer Natural Gas Project Areas for Potential Conflicting Commercial Production: Freshwater Bayou, Lake Theriot, and Kaplan Louisiana***

AUTHORS: Knutson, Carroll and Leo A. Rogers
PUBLISHER: C.K. GeoEnergy Corporation
PAGINATION: 25
PUBLICATION DATE: February 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10194
DESCRIPTORS: Fresh Water Bayou, Production Analysis, Lake Theriot, and Kaplan Field

SCOPE:

This report is essentially a continuation of the work that was reported previously by Rogers (1981) which analyzed three fields in Louisiana that were possible DOE geopressured geothermal prospects. The purpose of this report is to screen three additional proposed sites defined by the Louisiana State University resource assessment group for possible conflict with existing gas

production. This screening is based on the requirements of the DOE program that (1) only gas laden brine aquifers be considered and (2) that the proposed aquifers must not be connected to known producing gas reservoirs.

The three fields screened in this study were selected because of their current interest to the DOE. The analysis done here used the public records available at the Louisiana Department of Conservation offices in Baton Rouge, Louisiana and structural and stratigraphic interpretations made by the LSU. Resource assessment group. It was judged that these records and interpretations would be adequate for the preliminary screening covered in this report. A more comprehensive evaluation, which includes information from the operators in the areas, will be required prior to the serious consideration of one of the prospect areas.

The search of the Department of Conservation files included a search of the well log files, production files, well files, pressure files and hearing files. Each file had to be searched differently since the log files are cataloged by township and range; the well files are cataloged by API number; the pressure and production files are cataloged by field; and the hearing files are by docket number. Matching information from the different files is somewhat tedious because of difficulties in cross references and occasionally missing information. Because of the complexity in using the Department of Conservation files it is probable that wells were missed in the search. The complete well list be considered in any subsequent comprehensive evaluation.

TITLE: ***Solvent Extraction of Methane from Simulated Geopressured-Geothermal Fluids: Sub-pilot Test Results***

AUTHORS: Quong, Roland, Henry H. Otsuki, and Frank E. Locke
PUBLISHER: not given
PAGINATION: 26
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Solvent selection and solubility, Simulated geopressure fluid supply, Solvent extraction, and Methane determination

AUTHOR'S ABSTRACT:

The extraction of methane dissolved in 15 wt% sodium chloride solution at 150°C and 1000 psi has been demonstrated using n-hexadecane as the solvent in a sub-pilot scale extraction column operated in a continuous, countercurrent flow mode. Greater than 90% recovery of methane was obtained with solvent/brine mass flow ratios in the range of .040 - .045. The height of an ideal stage in this experimental Elgin-type spray column is estimated to be 1.5 ft. Application of this process on actual geopressured fluids is technically feasible, and when combined with direct drive injection disposal is economically attractive. Design and operation of a methane saturated-brine supply system to provide simulated geopressured fluid continuously at 150°C and 1000 psi are also described.

TITLE: ***Subsurface Geology and Geopressured/Geothermal Resource Evaluation of the Lirette-Chauvin-Lake Boudreaux Area Terrebonne Parish Louisiana***

AUTHORS: Lyons, William
PUBLISHER: University of Southwestern Louisiana Department of Geology
PAGINATION: 141
PUBLICATION DATE: December 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-ET-27161--T1
DESCRIPTORS: Stratigraphy and sedimentation, Structural geology, Sedimentation patterns, Geopressure/Geothermal resources potential, and Temperature studies

AUTHOR'S ABSTRACT:

The geology of a 125 square mile area located about 85 miles southeast of Baton Rouge and about 12 miles southeast of Houma, Louisiana, has been studied to evaluate its potential for geopressured/geothermal energy resources. Structure, stratigraphy, and sedimentation were studied in conjunction with pressure and temperature distributions over a broad area to locate and identify reservoirs that may be prospective. Recommendations concerning future site specific studies within the current area are proposed based on these findings.

Sediments of the stratigraphic interval studied are late middle to early-late Miocene in age and are characterized by the occurrence of the Bigenerina humblei through Textularia "L" articulata biostratigraphic zones. The depositional pattern during most of this interval was one of overall regression and shallowing of paleoecologic zones. Additionally, the section is observed to expand greatly from the north boundary of the study area to the south. The expansion is due to several large shelf-break hinge-line faults which were active during the time of deposition of much of the stratigraphic section studied.

Structurally, the area developed during the same interval of geologic time with most activity occurring before the end of Bigenerina "2" deposition. Uplifts in the area are probably shale-cored and are the result of heavy deposition the downthrown sides of simultaneously active hinge-line growth faults. To assist structural and stratigraphic interpretations, a single north-south seismic line was purchased and incorporated into the study. The well control and the seismic line were found to agree in detail; therefore, structural interpretations are probably fairly accurate.

After complete evaluation of the area, only one sand appears to be even marginally prospective. The Cyclammina sand, as it is here termed, is found over much of the northern part of the study area. The reservoir probably has a large continuous volume, especially in the northeastern quarter of the study area. Unfortunately, where the reservoir volumes are largest, the sand body is relatively deep. In addition, estimated temperatures of fluids in the reservoir are borderline under presently established geopressured/geothermal guidelines.

TITLE: ***Subsurface Evaluation of the Geopressured-Geothermal Chole Prospect Calcasieu Parish Louisiana***

SUBTITLE: ***A Thesis***

AUTHORS: Kurth, Randall J.
PUBLISHER: University of Southwestern Louisiana Department of Geology
PAGINATION: 103
PUBLICATION DATE: December 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-78ET27161
DESCRIPTORS: Geopressure, Stratigraphy, Depositional and structural history, and Reservoir investigation

SCOPE:

This report was conducted under research contract DE-AS05-78ET27161 for the Department of Energy to evaluate the geopressured-geothermal possibilities of the Chloe Prospect in Calcasieu Parish, Louisiana. The prospect was proposed by George Friedel (1978) in his ERDA study "Structure and Geothermal Relationships in the Lake Charles Area of Southwestern Louisiana." In the study Friedel concluded that the lower Hackberry sands of the Frio Formation were laterally continuous, thick sands within a pressured section that met the requirements for a nonelectrical geopressured-geothermal prospect. The purpose of the present study is to further refine the boundaries of the prospect, determine the reservoir parameters pertinent to production from the reservoir, and relate them to the geologic structure and stratigraphy of the area.

The study area is located within the Oligocene Hackberry Embayment of the Gulf Coast Geosyncline (Figure 1). The three major structural features in the area are the Gillis-English Bayou Dome, Iowa Dome, and the Manchester Anticline. The geopressured reservoir in the study area is the Lower Hackberry "A" massive sands. The sands rest unconformably on older beds ranging from Lower Frio to Vicksburgian. Maps of the unconformable surface and geometry of the sands suggest the Hackberry sands were deposited as turbidites within a submarine channel (Paine, 1968; Benson, 1971).

The study was conducted using electric log and paleontologic data for structural cross sections and maps. Reservoir data were compiled from a variety of sources including well logs, cores, bottom hole pressure tests, and chemical analyses of formation water.

TITLE: ***Sweet Lake Geopressured - Geothermal Project Magma Gulf- Technadril/DOE Amoco Fee***
SUBTITLE: ***Volume I Drilling and Completion Test Well and Disposal Well Annual Report for the Period 1 December 1979 - 27 February 1981***

AUTHORS: Rogers, R. W.--**EDITOR**
PUBLISHER: Magma Gulf-Technadril
PAGINATION: 320
PUBLICATION DATE: July 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80NV10081

DESCRIPTORS: Geology, General site activities, Occupational safety and health, Drilling and completion, Salt water disposal well, and Test well

SCOPE:

This report is an extended annual report covering the period from the inception of the contract on December 1, 1979, through the completion of drilling activities in February, 1981.

The Sweet lake site is located approximately 15 miles southeast of Lake Charles in Cameron Parish, Louisiana. It was selected by the Department of Energy under the Design Well Program of the Geopressured-Geothermal Energy Program. The Sweet Lake production well and disposal well were drilled under DOE Contract No. DE-AC08-80NV10081 to the Magma Gulf-Technadril Joint venture. Additional- funding was provided by the Gas Research Institute, under GRI Contract No. 5014-321-0290. These funds were used for mud logging, micropaleontology, organic geochemistry, and rock mechanics.

The Sweet lake site was selected to test the Frio Formation in Louisiana. The area was picked to optimize various important parameters. It was know from well logs that the pressures and temperatures are as high here as elsewhere in Louisiana, and thick, porous sands are present at an appropriate depth of 15,000' to 15,700'. Permeability data were unavailable but it was expected that the premeability in a sand of this type would be high. Salinity as calculated from well logs was expected to be 100,000 ppm.

A geological study by Magma Gulf Company under Contract No. E,-78-08-1561 showed that the major structure in this area is a graben. The dip of the beds is northwesterly into the basin. A well drilled into the deep basin would find the target sand below 18,000', at high pressures and temperatures. However, since there is no well control in the basin, the specific site was chosen on the 15,000' contour of the target sand in the eastern, more narrow part of the graben. Those key control wells are present within one mile of the test well. The information acquired by drilling the test well confirmed the earlier geologic study. The target sand was reached at 15,065', had a porosity of over 20% and a permeability to water of over 300 md. The original reservoir pressure was 12,060 psi and the bottom hole temperature 299 ^{0}F. There are approximately 250 net feet of sand available for perforation.

The test well was spudded August 22, 1980. The well was drilled without incident to 13,550' when the well took a kick. A random sidetrack was started at 10,564' and reached a total depth of 15,740. Three strings of pipe were used in this well: 13 3/8-inch from 4,050' to surface; 9 5/8-inch from 10,230' to surface; and 7 5/8-inch from 15,065' to surface; 7 5/8-inch from 15,065' to surface. The production tubing is a 5 1/2-inch liner from the plugged back total depth of 15,660' to the surface. Drilling operations were completed on February 26, 1981.

The disposal well was spudded on September 19, 1980 and was drilled to a total depth of 7440'. Two strings of pipe were used in the well: 13 5/8-inch from 1,375' to surface; and 9 5/8-inch from 7,436' to surface. The production tubing is a 7-inch liner set from plugged back total depth of 7350 to the surface. Drilling operations on this well were completed on October 13, 1980.

TITLE: ***Sweet Lake Geopressured - Geothermal Project Magma Gulf- Technadril/DOE Amoco Fee***

SUBTITLE: ***Volume II Surface Installations Reservoir Testing Annual Report for the Period 28 February 1981 - 10 February 1982***

AUTHORS: Hoffman, Karen S. --**EDITOR**
PUBLISHER: Magma Gulf-Technadril
PAGINATION: 124
PUBLICATION DATE: June 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80NV10081
DESCRIPTORS: Surface facilities, Well completion and perforation, Flow testing, Chemical analytical testing, and Inhibitor system

SCOPE:

Magma Gulf-Technadril/Department of Energy Amoco Fee 1 (production) salt water disposal wells were drilled in the period from August, 1980 to February 1981. Surface facilities were designed and constructed during March-June 1981. Flow testing began in June 1981 and continued until February, 1982.

The Miogypsinoides interval contains seven discrete sands in the test well. These sands have been numbered 1-7, beginning at the top of the sequence. Data from wireline logs and core samples suggested that the first zone to be perforated should be Sand 5. Because of its high porosity and permeability, Sand 5 was thought to contain almost 50% of the total hydraulic capacity of the well.

Flow testing of Sand 5 was performed in three stages, each of which is fully described in this report. Phase I was designed as an initial clean-up flow and a reservoir confirmation test. Phase II consisted of the reservoir limit determination test and lasted 17 days. Boundaries were confirmed which suggest that the Sweet Lake reservoir is fairly narrow, with boundaries on three sides, but is open in one direction with no closure for at least 4-1/4 miles. These boundaries approximate the shape of the graben in which the test well was drilled, but may or may not be directly related to the major faults forming the graben. Phase III testing was planned to be a long-term test at commercial design rates. Although Sand 5 alone would not support such rates, long-term production was demonstrated.

Additional research not supported by DOE funding was also performed during the period covered by this report. This research, consisting of mud logging, micropaleontology, organic geochemistry, core analysis, and rock mechanics, is summarized in this report, and presented by GRI-79/0125.

TITLE: ***Sweet Lake Geopressured - Geothermal Project***
SUBTITLE: ***Volume III Annual Report for the Period February 1982 - March 1985***
AUTHORS: Durham, C. O., F. D. O'Brien, R. W. Rodgers---**EDITORS**
PUBLISHER: Magma Gulf-Technadril
PAGINATION: 457
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80NV10081
DESCRIPTORS: Well facilities, Geology, Surface facilities, Reservoir testing, Chemical

analysis, Environmental monitoring, Economic, Abandonment, and Site restoration

SCOPE:

This is Volume III, the final report to the U.S. Department of Energy on the Magma Gulf-Technadril Inc. geopressured well testing project of the Amoco No. 1 (Sweet Lake) well in Cameron Parish, Louisiana. This report presents the results of the testing of Sand 3 (15,245 - 15,280 feet in depth) which occurred from November 1983 to March 1984 and evaluates these new data in comparison to results from the testing of Sand 5 (15,385 - 15,415 feet in depth) which occurred form to June 1981 to February 1982. It wells preparatory to the Sand 3 testing as well as the plug and abandon procedures requested to terminate the project.

The period treated in this report extends from the termination of the Sand 5 test in February 1982 to the final plug and abandon completed in November 1984. The present report effectively serves as the annual reports for the third and fourth years of the project from February 11, 1982 to completion of the contract, concluded with submission of this report in March, 1985. During a major portion of this period operations were suspended for lack of funding to rework the wells preparatory to additional testing.

TITLE: ***Seismic Studies in Austin-Pleasant Bayou and Cuero Prospects --A Summary of Research Activities***
SUBTITLE: ***Technical Report for the period February 1, 1980-October 31, 1980***

AUTHORS: Morton, R.A., C.D. Winker, and D.A. Garcia
PUBLISHER: Bureau of Economic Geology
PAGINATION: 57
PUBLICATION DATE: November 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-76ET28461
DESCRIPTORS: Structure, Reservoir continuity, and Seismic data acquisition, processing, and results

SCOPE:

Studies based partly on pre-existing or recently acquired seismic data are designed to confirm or improve the geological interpretation and resource assessment of geopressure geothermal prospect areas in Texas.

Other objectives are (1) to evaluate seismic signatures as indicators of lithologic properties, (2) to assist in projecting structural and stratigraphic information beyond the limits of well control, and (3) to investigate processing techniques that enhance data displays by improving signal-to-noise ratios and suppressing multiples in the deep objective section.

Two prospect areas with contrasting structural styles and geologic histories were selected for detailed investigations of sedimentation and structural development using available electric logs and geophysical surveys. In the first area, near Cuero, De Witt County, Texas, new seismic data acquired for the study were supplemented both with lines donated for research purposes and with data

purchased commercially. Together these data provide optimum coverage across the objective fault blocks where lower Wilcox sediments are geopressured. The second study area includes the Austin Bayou Prospect, Brazoria County, Texas, where the Pleasant Bayou # 2 well was drilled and completed in the Frio Formation. Original plans called for new seismic shooting across the Austin Bayou Prospect; however, these plans were canceled after delays in obtaining and processing the Cuero data experienced by the subcontractor due to bad weather, permit problems, and personnel changes. Also contributing to the change in plans was the limited response to a request for bids sent to several geophysical contractors operating in the area.

TITLE: ***Simulation of Irreversible Rock Compaction Effects on Geopressure Reservoir Response***
SUBTITLE: ***Topical Report Dec. 1986***

AUTHORS: Riney, T.D.
PUBLISHER: S-Cubed
PAGINATION: 76
PUBLICATION DATE: December 1986
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: Rock Mechanics, Bilinear compaction model, Parametric calculations, Simple drawdown/buildup, and Simulated well test

AUTHOR'S ABSTRACT:

A series of calculations are presented which quantitatively demonstrate the effects of nonlinear stress-deformation properties on the behavior of geopressured reservoirs. The range of stress-deformation parameters considered is based on information available from laboratory rock mechanics tests performed at the University of Texas at Austin and at Terra Tek, Inc. on cores recovered from geopressured wells. The effects of irreversible formation rock compaction, associated permeability reduction, and repetitive load/unload cycling are considered. The formation rock and geopressured brine properties are incorporated into an existing reservoir simulator using a bilinear model for the irreversible compaction process. Pressure drawdown and buildup testing of a well producing from the geopressured formation is simulated for a suite of calculations covering the range of formation parameters. The results are presented and discussed in terms of the inference (e.g., permeability and reservoir volume) that would be drawn from the simulated test data by an analyst using conventional methods.

TITLE: ***Single Well Study Gladys McCall Well No. 1 Cameron Parish, Louisiana***
SUBTITLE: ***Final Report***

AUTHORS: not given
PUBLISHER: Scientific Software-Intercomp
PAGINATION: 35
PUBLICATION DATE: August 1983
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-AC-08-78ET-11395
DESCRIPTORS: Petrophysics, Geology, Flow test, and Reservoir simulation

SCOPE:

The purpose of INTERCOMP's contract with DOE is to provide petrophysical and reservoir analysis for wells drilled into geopressured-geothermal aquifers containing dissolved methane.

The study of the Gladys McCall Well No. 1 proceeded in two phases. The drawdown and buildup tests were analyzed to estimate the permeability of the formation and skin near the wellbore. Secondly, the pressure tests were simulated using INTERCOMP's mathematical reservoir simulator, BETA II, to characterize the reservoir.

TITLE: ***Some Problems Involved With Sampling Geothermal Sources***

AUTHORS: Stoker, Purtymen
PUBLISHER: Los Alamo Scientific Laboratory
PAGINATION: 30
PUBLICATION DATE: October 1975
SPONSOR: U.S. Atomic Energy Commission
REPORT OR CONTRACT#: W-7409-ENG
DESCRIPTORS: Sampling methods, Fluid composition, and Hydrologic systems

AUTHOR'S ABSTRACT:

Geothermal wells must be sampled for a variety of purposes including geologic and geochemical interpretation, engineering design of facilities, environmental release evaluation, and documentation of baseline conditions. Basic factors influencing the choice and application of sampling methods are reviewed including the type of the geothermal resource, the analyses of interest, well production parameters, utilization processes, and possible sample contamination or instability. Three basic methods of sampling are described including condensation, phase separation, and use of evacuated containers. Several practical problems experienced by various workers are discussed. These include the natural variability of fluid composition with time, effects of well-bore heat losses, effects of well flow rate and production time, sampling locations, laboratory simulation studies, contamination by corrosion reaction, and documentation of hydrologic systems possibly connected to the geothermal resource.

TITLE: ***Statement of Programmatic Objectives of the geothermal Technology Division***
SUBTITLE: ***Volume I & II - April 14, 1988***

AUTHORS: not given
PUBLISHER: Department of Energy
PAGINATION: not given
PUBLICATION DATE: April 1988
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Cost-of-power model, Hydrothermal, Geopressured Geothermal, Hot dry rock, and Magma

SCOPE:

This document contains the multipurpose objectives of the geothermal energy research program sponsored by the Department of Energy. Those objectives will govern the direction of our future research. Through this document we seed to inform persons with an interest in geothermal energy about our research objectives for the next decade. In addition, we solicit comment from those persons on the appropriateness and relevance of those objectives.

TITLE: ***Statutory Requirements for Ambient and Effects Monitoring at DOE Energy Activity Sites***

AUTHORS: Sanders, F. S., R. M. Reed, E.E. Huber, and C.S. Tucker
PUBLISHER: Oak Ridge National Laboratory
PAGINATION: 104
PUBLICATION DATE: November 1979
SPONSOR: DOE
REPORT OR CONTRACT#: W-7405-ENG-26
DESCRIPTORS: Federal laws and Statutory monitoring requirements

AUTHOR'S ABSTRACT:

Major federal environmental protection legislation, regulations, and regulatory implementation procedures were reviewed and summarized with respect to site-specific ambient and ecological effects monitoring requirements at DOE energy activity sites. Three states (California, Wyoming, and Maryland) were also considered with respect to their implementation of federal regulations (as permitting states) plus any state requirements for environmental monitoring that are in addition to federal needs. It was found that, except for the National Environmental Policy Act (NEPA), little ecological effects monitoring is actually is required under federal statutes. For instance, some pre-application effects monitoring (before a discharge permit is issued) is required for atmospheric and aqueous waste discharge, under the Clean Air Act of 1977 and the Clean Water Act of 1977,

respectively, but no follow-up monitoring is usually required as would provide for site-specific ecological impact assessment of permitted activities. Some extensive pre-application ambient monitoring may be required under non-NEPA federal statutes but little follow-up (compliance) monitoring is evident. Concern for environmental quality at the state level is more closely attuned to local environmental degradation, but states lack monitoring resources and, in general, add no additional requirements to federal regulatory needs. NEPA provides the only realistic guidelines for ecological effects assessment under current interpretation of federal and state environmental protection legislation. This act will undoubtedly continue to be the main guide to the investigation of ecological changes from ongoing and proposed federal activities, including the promotion of new energy technologies by DOE.

TITLE: ***Structural and Depositional Evolution of South White Lake Area; Vermilion and Cameron Parishes, Louisiana***
SUBTITLE: ***A Thesis***

AUTHORS: Ross, Steven
PUBLISHER: Department of Geology Louisiana State University
PAGINATION: 175
PUBLICATION DATE: May 1983
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Stratigraphy, Structure, Depositional environment, Fluid properties, and Synthesis

AUTHOR'S ABSTRACT:

Structural and depositional data from detailed correlation of approximately three hundred wireline surveys in southwestern Vermilion and southeastern Cameron Parishes indicate that sedimentary accumulation patterns are influenced by faulting patterns and relative structural highs. Early and middle Miocene structural and depositional patterns are similar, and structural growth on faults and apparent sedimentary accumulation rates are correlative. In addition, in rocks of the same age, high sandstone percentages, are commonly associated with growth faults. The sediment accumulations themselves, where associated with growth faults, appear to have facilitated the formation and maintenance of the faults. In some cases, local areas of higher sediment accumulation later became positive structural features, especially near the edge of deltaic deposition, as in Constance Bayou and West Deep Lake fields.

Growth faulting was particularly important during times of major sediment influx, such as in the Marginulina ascensionensis and Robulus '43' - Operculinoides time intervals. Sandstones during the Marginulina ascensionensis and Liebusella intervals developed channels and built up bar sands along faults, which were the areas of maximum subsidence. Channel-fill and bar sands tended to be deposited in the same general area and trend throughout Marginulina ascensionensis time. Along with the close proximity of these environments to faults, this implies a genetic relationship between areas of subsidence and sand-rich environments.

Fluid movement, as implied by thermal and abnormal pressure anomalies, is probably associated with faults in the area. Fluids may move upward along faults, as indicated by the proximity of elevated temperature anomalies to faults on isothermal maps. Bifurcated faults, particularly, may have served as avenues for the release of fluids under abnormal pressure, downdip of bifurcated faulting and the elevated thermal anomalies associated with these faulted areas.

TITLE: ***Subsurface and Seismic Investigation of the Geopressured-Geothermal Potential of South Louisiana Abbeville Area, Chloe Area, Turtle Bayou Field-Kent Bayou Field Area, Lirette-Chauvin-Lake Boudreaux Area***
SUBTITLE: ***Final Report September 1, 1978- September 30, 1983***

AUTHORS: Kinsland, Gary, Paine R. William, Michael P. Duhon, James R. Dungan, Randall J. Kurth, Daniel R. Moore, and Williams Lyons
PUBLISHER: Department of Geology University of Southwestern Louisiana
PAGINATION: 410
PUBLICATION DATE: October 1983
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS05-78ET27161
DESCRIPTORS: Depth of geopressured sands, Geopressured sand volumes, Porosities, Permeabilities, Temperatures, Salinities, Dissolved gas content, Structure, and Petroleum production

SCOPE:

The contract under which this work has been accomplished has been held at The University of Southwestern Louisiana from September 1978 until now, October 1983. The general goal of the contract has been evaluation of specific sites (areas) for geopressured-geothermal energy potential. Four areas have been evaluated: 1) Abbeville Area, 2) Chloe Area, 3) Turtle Bayou Field-Kent Bayou Field Area and 4) Lirette- Chauvin -Lake Boudreaux Area. The Abbeville and Chloe Areas were proposed by Bill Paine prior to the initiation of the contract. The latter two areas were chosen in conjunction with studies in progress at the Louisiana Department of Natural Resources.

TITLE: ***Subsidence Monitoring at Two Geopressured Wells in LA.***
SUBTITLE: ***Annual Report Nov. 1980 to 1981***

AUTHORS: Staton, Thomas
PUBLISHER: Gas Research Institute
PAGINATION: 65
PUBLICATION DATE: January 1982
SPONSOR: Gas Research Institute
REPORT OR CONTRACT#: 5080-351-0352

DESCRIPTORS: Subsidence, Gulf Coast, Tiltmeter monitoring, First order leveling, and Microseismic monitoring

SCOPE:

A ground deformation monitoring array was installed at the Sweet Lake geopressured methane well site. The monitoring network consisting of closely spaced first order level marks, relevelled monthly, and tiltmeters of varying sensitivities (with both) continuous and periodic readout schedules. The network is operated in conjunction with a microseismic monitoring array of eight seismometers located about the well site. The combined network system has been operating since May 1981, and has provided data regarding both regional ground deformation and microseismic activity. To date, no correlation has been established between ground deformation (neither elevation fluctuation or tilt) or microseismic activity detected within the well site area. All detected deformation, and microseismic activity appears to be the result of ongoing processes within the area, although continued data collection will provide insight into the contribution, if any, to these ongoing processes made by pumping activities associated with the Sweet Lake geopressured well.

TITLE: ***Summary of Environmental Investigation of A Closed Reserve Pit Located Within The Pleasant Bayou Geopressured /Geothermal Lease***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: not given
PUBLICATION DATE: November 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-85ID12578
DESCRIPTORS: Remediation and Hazardous substances

SCOPE:

As requested by the U.S. Department of Energy, Idaho Falls, Idaho Operations Office (DOE-ID), Eaton Operating Company, Inc. (EOC), as a prime contractor to DOE-ID under Contract No. DE-AC07-85ID12578, initiated an environmental investigation on August 25, 1991 of the closed reserve pit located on the Pleasant Bayou site. This investigation consisted of collecting twenty-four (24) soil samples, 12 from a depth of 5" and 12 from 6', and analyzing each one for nine (9) heavy metals, plus Hexavalent Chromium, five (5) anions, and four (4) cations.

These tests were conducted to establish the composition of the soil from within the pit (samples, test no. 1 thru 10) and from two sites outside the pit area (control no. 1 and 2).

The results would determine whether the pit closure performed by Fenix & Scisson, Inc. in 1984 continued to satisfy federal, state and/or local regulations, or whether additional analytical work was called for to establish if follow-up remediation was required.

TITLE: ***Summary of Ground/Surface Water Sampling Conducted By IT at the Pleasant Bayou, Willis Hulin and Gladys McCall Sites on January and February 1990, July 1990, October and November 1990, January 1991, April 1991, August 1991, November 1991, January 1992, February 1993, May 1992, September 1992, and May 1993***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: N/A
PUBLICATION DATE: see above
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-92ID12944
DESCRIPTORS: Pleasant Bayou ground/surface water analyses, Willis Hulin ground/surface analyses, and Gladys McCall ground/surface analyses

SCOPE:

These reports contain results of analyses of surface and ground water samples collected at Hulin, Gladys McCall, and Pleasant Bayou. Included in each report is an evaluation of analytical laboratory water analyses, location maps identifying the individual sampling sites on each of the three locations, chain of custody records, sample log sheets, graphical display for each metal having an analytical results above the lab's detection limit, and all analytical results.

TITLE: ***Surface Geology and Potential for Geopressured-Geothermal Energy in the Turtle Bayou Field-Kent Bayou Field Area, Terrebonne Parish, Louisiana***
SUBTITLE: ***Thesis***

AUTHORS: Moore, Daniel R.
PUBLISHER: Department of Geology University of Southwestern Louisiana
PAGINATION: 120
PUBLICATION DATE: September 1982
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Structure, Stratigraphy, and Paleontology

SCOPE:

A 216 square mile area approximately 65 miles southwest of New Orleans, Louisiana, has been geologically evaluated to determine its potential for geopressured-geothermal energy production. The structural and stratigraphic analyses were made with emphasis upon the Early and Middle Miocene age sediments which lie close to and within the geopressured section.

Stratigraphically the area exhibits a lithologic section which is typical of many areas in southeast Louisiana. The deepest sediments penetrated are within uppermost Lower Miocene. Paleontological evidence suggests that these sediments were deposited in transgressing environments. In contrast, the overlying Middle Miocene section was deposited during what appears to have been an overall regression of environments.

Structurally, the study area is bounded on the north and south by two relatively large, regional, northeast-southwest trending fault zones. A fault zone similar to these runs through the central part of the study area and marks the northern boundary of what-has been termed the Houma embayment. Structurally the study (Sloane. 1966). Evidence from this study is consistent with that-presented by Sloane (1966), and suggests that the Houma embayment was initiated in an outer shelf to slope edge environment at a time dating no later than the Cibicides opima zone. Embayment infilling was essentially complete by the end of Bigenerina humblei zone deposition.

Three geopressured sands, the Robulus (43) sand, Cibici-des opima sand, and Cristellaria (I) sand, are evaluated for their potential of producing geothermal energy. Two of these sands, the Robulus (43) sand and the Cibicides opima sand, meet several of the United States Department of Energy's suggested minimum requirements for a prospective geopressured- geothermal energy reservoir.

TITLE: ***Significant Test Results, Energy Potential, and Geology of Some Gulf Coast Geopressured-Geothermal Sandstone Reservoirs***

AUTHORS: John, Chacko and Donald Stevenson
PUBLISHER: AAPG Annual Convention--South Texas Geological Society
PAGINATION: N/A
PUBLICATION DATE: April 1989
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured-geothermal reservoirs, Productions, and disposal

SCOPE:

Geopressured-geothermal reservoirs found in the northern Gulf of Mexico basin represent a large potential future energy resource. Three reservoirs in various stages of developmental testing are of current interest. Over a four-year testing period the Gladys McCall #l (Cameron Parish, Louisiana) produced 27.3 million bbl of brine and 676 million scf of gas at an average rate of 20,000 bbl/day from perforations between 15,158 and 15,490 ft. This lower Miocene sandstone section forms part of a genetic unit of interconnected channel and point-bar sandstones deposited in a lower shelf environment. Pleasant Bayou 2 well (Brazoria County, Texas) is currently being flow-tested at 20,000 bbl/day and has a gas/brine ratio of approximately 23 scf/stb and a temperature of 291 °E An electric energy conversion system being set up here will test potential for electric generation from geopressured- geothermal energy. Superior Hulin #l (Vermilion Parish, Louisiana) is a deep (21,549 ft) former gas well proposed to be completed as a geopressured-geothermal well. Initial log analysis indicates that a 570- ft thick sandstone, of probable submarine fan origin, may contain free gas in addition to solution gas and may thus represent an economically feasible geopressured-geothermal well. Gas-separated brine is disposed by subsurface injection into disposal wells. However, in areas where hydrocarbon fields with wells penetrating geopressured sands are

present. hot brines could be injected into depleted hydrocarbon zones to aid secondary recovery.

The production and disposal of large volumes of geopressured geothermal fluids present the potential for significant environmental problems associated with land subsidence, growth fault activation, and water quality. Hence, an environmental studies and monitoring program has been established with the aid of 13 continuous microseismic recording stations, surveyed benchmarks tied to National Geodetic Survey regional networks, and observation water wells. So far, no observable long-term detrimental effects have been noted.

TITLE: ***Structural Styles of the Wilcox and Frio Growth-Fault Trends in Texas: Constraints on Geopressured Reservoirs***
SUBTITLE: ***BEG Annual Report 1986***

AUTHORS: Ewing, T. E.
PUBLISHER: Bureau of Economic Geology University of at Austin
PAGINATION: not given
PUBLICATION DATE: 1986
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Wilcox and Frio growth-fault trends

SCOPE:

Subsurface geological and seismic study of structural styles in the Wilcox and Frio growth-fault trends in selected areas of the Texas Gulf Coast.

Structural variability is a key determinant of the size of geopressured aquifers in the deep subsurface. Discovery of large geothermal reservoirs in the geopressured zone depends on the favorable intersection of large-volume, high-quality sandstone bodies and large-area fault compartments. In this report the wide variability in structural styles within the growth-faulted, geopressured trends of the Texas Gulf Coast is illustrated by detailed structural maps of Wilcox and Frio growth-fault trends and quantified by statistical analysis of fault compartment geometries. Within the Frio growth-fault trend the Sarita, Corpus Christi, and Port Arthur areas, together with the previously studied Blessing and Pleasant Bayou prospects, span nearly the entire range of Frio depositional systems. The Frio and Wilcox growth-fault trends show distinct differences. The author concludes that Wilcox sandstones tend to be dip-elongate, whereas fault compartments are highly strike-elongate; the probability of large reservoirs is consequently low. Frio sandstones are of mixed geometry, and fault compartments are larger and more equant, suggesting an increased chance of finding large reservoirs.

TITLE: ***Supercritical Binary Geothermal Cycle Experiments with Mixed-Hydrocarbons Working Fluids and a Near-Horizontal in-Tube Condenser***

AUTHORS: Bliem, C. J. and G.L. Mines

PUBLISHER: Idaho National Engineering Laboratory EG&G
PAGINATION: 7
PUBLICATION DATE: December 1989
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID0157
DESCRIPTORS: Supercritical technology and Horizontally oriented condenser

AUTHOR'S ABSTRACT:

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting improved utilization of moderate temperature geothermal resources. Testing at the Heat Cycle Research Facility which was located at the DOE Geothermal Test Facility, East Mesa, California is presently being conducted to meet this objective. The testing effort discussed in this interim report involves a supercritical vaporization and counterflow in-tube condensing system with a near horizontal tube orientation. A previous report explored the supercritical heating, supersaturated turbine expansions and the condenser performance in the vertical orientation. This report presents a description of the test facility and results from a part of the program in which the condenser was oriented in a nearly horizontal orientation.

Results of the experiments for the in-tube condenser in a nearly horizontal orientation are given for both pure and mixed-hydrocarbon working fluids. Although most of the data is for a completely active condenser in countercurrent flow, some data is available for a configuration in which half of the tubes were plugged and some data for cocurrent (parallel) flow is analyzed. The horizontal-oriented condenser behavior predicted by the Heat Transfer Research Institute computer codes used for correlation of the data was not in agreement with experimental results at this orientation. Some reasons for this difference are discussed. A special series of tests, conducted with propane and up to approximately 40% isopentane concentration, indicated that a close approach to "integral" condensation has occurred as was the case with the horizontally oriented condenser (similar results were obtained for the vertical condenser).

TITLE: ***Sweet Lake Geopressured-Geothermal Project, Magma Gulf - Technadril/Doe Amoco Fee***
SUBTITLE: ***Volume II: Surface Installations Reservoir Testing Annual Report for the Period February 28, 1981-February 10, 1982***

AUTHORS: Hoffman, Karen S. --**EDITOR**
PUBLISHER: Office of Scientific and Technical Information DOE
PAGINATION: not given
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC008-80NV10081
DESCRIPTORS: Flow test, Reservoir, and Production

SCOPE:

The Magma Gulf-Technadril/Department of Energy Amoco Fee - 1 (production) and salt water disposal wells were drilled in the period from August, 1980 to February 1981. Surface facilities were designed and constructed during March-June 1981. Flow testing began in June 1981 and continued until February, 1982.

The Miogypsinoides interval contains seven discrete sands in the test well. These sands have been numbered 1-7, beginning at the top of the sequence. Data from wireline logs and core samples suggested that the first zone to be perforated should be Sand 5. Because of its high porosity and permeability, Sand S was thought to contain almost 50%o of the total hydraulic capacity of the well.

Flow testing of Sand S was performed in three stages, each of which is fully described in this report. Phase I was designed as an initial clean-up flow and a reservoir confirmation test. Phase II consisted of the reservoir limit determination test and lasted 17 days. Boundaries ,ere confirmed which suggest that the Sweet Lake reservoir is fairly narrow, with boundaries on three sides, but is open in one direction with no closure for at least 4-1/4 miles. These boundaries approximate the shape of the graben in which the test well was drilled, but may or may not be directly related to the major faults forming the graben. Phase III testing was planned to be a long-term test at commercial design rates. Although Sand 5 alone would not support such rates, long-term production was demonstrated.

Additional research not supported by DOE funding was also performed during the period covered by this report. This research, consisting of mud logging, micropaleontology, organic geochemistry, core analysis, and rock mechanics, is summarized in this report, and presented by GRI-79/0125.

TITLE: ***Technical Report No.81-1***
SUBTITLE: ***Microseismicity Observed at the Bayou Parcperdue Geopressured Well Test Site Aug-Dec. 1980***

AUTHORS: Woerpel, Craig and Fred Mauk
PUBLISHER: Teledyne Geotech
PAGINATION: 14
PUBLICATION DATE: February 1981
SPONSOR: DOE and Louisiana Geological Survey
REPORT OR CONTRACT#: not given
DESCRIPTORS: Site installation, Data Collection, and Data procedures

SCOPE:

An experimental geopressured-geothermal well is to be drilled near Bayou Parcperdue in Vermillion Parish, Louisiana. High rate flow testing of this relatively small well-defined reservoir will simulate the effects of long- term production and significantly deplete the reservoir. As a result, this project would be more likely than previous tests to induce large cumulative shearing strains in rock surrounding the reservoir. Localized brittle fracture and accelerated movement on growth faults are possible modes for dissipating this strain.

Magnitudes of the resulting seismic waves and surface subsidence cannot be accurately predicted theoretically; thus, they must be closely monitored in the field. A seismic array has been installed by Teledyne Geotech under contract to the Louisiana Geological Survey which will continuously record ground motion in the area. Analysis of these recordings will provide a better understanding of possible risks which might be increased by geopressured- geothermal production.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the period 1 November 1982 to 31 October 1983***

AUTHORS: Groat, C. G. --**PROGRAM COORDINATOR**
PUBLISHER: Louisiana State University Louisiana Geological Survey
PAGINATION: 164
PUBLICATION DATE: October 1984
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10174
DESCRIPTORS: Water Quality, Subsidence monitoring, and Microseismic monitoring

SCOPE:

This annual report describes environmental monitoring activities carried out by Louisiana State University under U.S. Department of Energy Contract DE-AC08-81NV10174 for the period 1 November 1982 through 31 October 1983. This report is a progress report in the sense that it discusses program components, provides data, and presents preliminary interpretations. The monitoring program continues and will be the subject of subsequent annual reports.

TITLE: ***Technadril-Fenix & Scisson T-F&S/DOE Gladys McCall No. 1 Well Cameron Parish, Louisiana***
SUBTITLE: ***Reservoir Limit Test Data Sand Zone No. 8, (15,158-15490 ft) October 7-November 30, 1983***

AUTHORS: not given
PUBLISHER: Reservoir Dynamics, Inc.
PAGINATION: 165
PUBLICATION DATE: 1983
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:
Data only.

TITLE: ***Technical Report No.82-1***
SUBTITLE: ***Microseismic Monitoring of Bayou Parcperdue Louisiana: The Dow L. R. Sweezy No.1 Geopressured/Geothermal Energy Test Well Program 1981 Annual Progress Report***

AUTHORS: Mauk, Frederick,J.
PUBLISHER: Teyedyne Geothech
PAGINATION: 64
PUBLICATION DATE: January 1982
SPONSOR: Louisiana Geological Survey and Louisiana State University Department of Geology
REPORT OR CONTRACT#: not given
DESCRIPTORS: Seismograph Station Design, Network design and limitations, Data analysis, and Analysis procedures

SCOPE:

Commercial utilization of the geopressured brines underlying the Gulf Coast as unconventional geothermal-methane energy sources is dependent upon high volumetric production rates. The production requirements for effective withdrawal and disposal of these highly saline brines is believed to be near 3 X 104 bbl/day/well. Such high volumetric productions can alter substantially the ambient state of stress of the local geological column potentially resulting in reactivation of preexisting zones of weakness as well as causing new fracture development.

To investigate normal ambient seismicity as well as potentially enhanced seismic activity induced by brine production, Teledyne Geotech, with the authorization of the Louisiana State University and Louisiana Geological Survey, has conducted a seismic monitoring program in the vicinity of the Bayou Parcperdue geopressured test well (the DOW L. R. Sweezy No. 1) since August 1980. Although the L. R. Sweezy No. 1 well has been completed and perforated at depths of 13,368 to 13,388 feet (4,074.6 - 4,080.7 m) and 13,394 to 13,406 feet (4,082.5 - 4,086.2 m) in the Cib jeff sand, testing of the well and/or production of brines have not been accomplished. This report describes the operation of the seismic monitoring network and results obtained from January through November, 1981.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Final Report For the Period September 27, 1978- December 31, 1980***

AUTHORS: Wrighton, Fred M., Don Babbitt, Dale R. Carver, Charles Groat, and Adrain E. Johnson, Jr.
PUBLISHER: DOE
PAGINATION: 359

PUBLICATION DATE: August 1981
SPONSOR: DOE
REPORT OR CONTRACT#: AS05-78ET27160
DESCRIPTORS: Well data, Resource assessment, Geologic studies, and Environmental monitoring

SCOPE:

This is a report of technical support and research activities conducted under the Department of Energy Contract No. DE-AS05-78ET- 27160 over the term August 1, 1978, through December 31, 1980. The objective of this contract was to provide coordination assistance of the research and development effort in the Louisiana Gulf Coast Geopressured-Geothermal Program, particulary technical support for the development of the geopressured test-well program and management and supervision of a comprehensive environmental monitoring program for the wells drilled in Louisiana. Achievement of this objective required, in part, the development of a drilling and well testing plan and an environmental monitoring plan. The initial coordination and technical support effort was directed toward a drilling site identified at Lafourche Crossing. This site was not drilled and tested, however, so the contract activity was directed toward other sites that were drilled.

The research conducted over the original contract and subsequent continuation amendments provided analysis and support in several subject areas. Test well data support was provided in rock mechanics studies and subsidence simulation. Resource assessment provided detailed geologic studies of specific sites and regional geologic analysis. Environmental monitoring work established the monitoring systems and baseline environmental measurements for sites. Finally, systems analysis utilized data and estimates from all researchers involved to evaluate the potential of identified sites.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report Nov.1,1980-Oct.31,1981***

AUTHORS: Babbitt, D.G., Z. Bassiouni, D.R. Carver, C.G. Groat, R.H. Pilger,Jr., and F.M. Wrighton
PUBLISHER: DOE
PAGINATION: 315
PUBLICATION DATE: March 1982
SPONSOR: DOE
REPORT OR CONTRACT#: AC08-81NV10174
DESCRIPTORS: In- place methane resource assessment, Geopressured-geothermal resource, Geophysics, Diagenesis, Geochemistry, Rock mechanics, Subsidence modeling, Information systems, and Environmental monitoring

SCOPE:

The research conducted at Louisiana State University (LSU) on the geopressured-geothermal project has been assembled here under a single contract and includes a broad spectrum of activities. Research functions and organizations responsible for their completion include Program Management

(Louisiana Geological Survey), Resource Assessment (Louisiana Geological Survey), Site-Specific Studies (Department of Geology), Rock Mechanics and Subsidence Modeling (Department of Civil Engineering), Reservoir Analysis and Simulation (Department of Petroleum Engineering), Systems Analysis and Scientific Support (Department of Chemical Engineering), Information Systems (Energy Programs Office), and Environmental Monitoring (Louisiana Geological Survey). Significant accomplishments have been achieved in each of these functions.

The Program Management Function was responsible for all coordination, budgeting, and reporting for all functions. The Fifth Conference on Geopressured-Geothermal Energy was convened in Baton Rouge, and the papers from the Conference were published in the Transactions.

The Resource Assessment Function completed the assessment of the solution-gas resource; the total in-place solution-methane resource of 371 TCF was estimated to be present in the Wilcox, Frio, and Miocene sandstones of onshore Louisiana. The Bayou Hebert Prospect, considered by many as one of the most favorable sites for the location of a designed test well, was studied in detail. Thick sandstones do occur within the geopressured zone, but it was determined that water salinities are excessive according to present standards.

The Site-Specific Function was responsible for conducting detailed studies of prospective areas using seismic data where present. The geological investigation of the Southeast Pecan Island Prospect has been completed and is reported on here. A new prospect located at the northeastern side of the area was delineated as very favorable and is recommended here as a future potential prospect because of the presence of thick sandstone units in a large fault block and low formation-water salinity.

The Rock Mechanics and Subsidence Modeling Function focused activity primarily on the Parcperdue test-well site. Detailed computer modeling has indicated that, upon complete drawdown of the prospective reservoir, subsidence at the surface will be approximately 0.004 feet.

The Reservoir Analysis and Simulation Function was responsible for conducting reservoir engineering studies utilizing data from the designed test wells because none of the wells in Louisiana were producing within the contract period, this activity was not feasible. However, because of the difficulty in determining salinity from well logs, research in this function centered on developing a method of analysis which will produce results closer to those from water analyses.

The Annual Report on the Systems Analysis and Scientific Support was not available at the time of this publication and will be submitted by the Principal Investigator to DOE at a later date.

The Information Systems Function set up an Information Center for Geopressured-Geothermal (ICGG) research utilizing resources and data available from research in Louisiana. A computerized data base was developed which incorporates results of resource assessment and test-well activities. The computer capabilities of the group are also being used to store and manipulate environmental monitoring data from the designed test wells.

The Environmental Monitoring Function was responsible for designing and conducting all monitoring of environmental impacts resulting from production from the three geopressured-geothermal designed test wells in Louisiana. This activity is continuing on the three wells.

TITLE: ***Technical Support for Geopressure-Geothermal Well Activities***
SUBTITLE: ***Annual Report for the Period Nov. 1, 1981 - Oct. 31, 1982***

AUTHORS: Babbitt, D. G., Z. Bassioui, D. R. Carver, C. G. Groat, A. E. Johnson, Jr., and F. M. Wrighton

PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 454
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10174
DESCRIPTORS: Resource assessment, Rock mechanics, Subsidence modeling, Reservoir analysis, Simulation, Systems analysis and support, Information system, and Environmental monitoring

SCOPE:

This annual report of technical support and research covers work done by Louisiana State University during the period 1 November 1981 to 31 October 1982 under Department of Energy (DOE) Contract DE-AC08-81NV10174. The overall purpose of this contract is to provide additional technical support for the DOE program to develop the geopressured-geothermal resource. Specifically, the objectives of the contract are 1) to coordinate ongoing and new projects funded by the geopressured-geothermal program, 2) to provide technical advice for the drilling and testing of the wells included in the DOE four-well and wells of opportunity programs in Louisiana, 3) to act as a repository for all data obtained from the geopressured-geothermal test wells drilled in Louisiana, and 4) to manage and supervise a comprehensive environmental monitoring program for each designed test well in Louisiana.

TITLE: ***Technical Support for Geopressure-Geothermal Activities in Louisiana***
SUBTITLE: ***Final Geological Report for the Period Nov, 1, 1981 to Oct. 31, 1982***

AUTHORS: Pilger, Rex
PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 455
PUBLICATION DATE: June 1984
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10174
DESCRIPTORS: Geophysics, Diagnosis, Geochemistry, and Structure

SCOPE:

The South White Lake area is located approximately 50 miles south of Lake Charles, Louisiana, in southeast Cameron and southwest Vermilion parishes (Fig. 1). Seven oil and gas fields are included in the area, which covers about 175 square miles. This study was undertaken in an effort to evaluate geologic aspects of the South White Lake area as a potential geopressured geothermal energy prospect.

A genetic relationship between sedimentary and structural patterns has been noted since growth

faults were first recognized along the northern margin of the Gulf of Mexico area (Camb. 1961). A better understanding of this relationship could give insight into the extent of geopressured-geothermal and oil and gas reservoirs and the structural relief often associated with growth faulting. The relationship between depositional and structural patterns will also have some bearing on the definition of paths of fluid migration. As a consequence, this study evaluates the relationship between structural and depositional patterns and the relationships of these patterns of parameters connected with fluid migration, i.e., temperature and abnormal pressure.

The topics covered by this study include stratigraphy, structure, depositional environment, temperature, and fluid pressure. Patterns of structural and depositional development are compared to ascertain their mutual relationships. Variations in fluid parameters are considered because they also are indicative of structural and, perhaps, depositional history and have a bearing on problems associated with hydrocarbon migration.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Final Report for the period November 1, 1983 to October 31, 1984***

AUTHORS: Groat, C.G.
PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 110
PUBLICATION DATE: December 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10174
DESCRIPTORS: Water quality monitoring, Subsidence monitoring, Geopressured-geothermal development, and Microseismic monitoring

SCOPE:

This report describes environmental monitoring activities carried out by Louisiana State University (LSU) under U.S. Department of Energy Contract DE-AC08-81NV10174 for the period 1 November 1983 through 31 October 1984. This is a progress report in the sense that it discusses program components, provides raw data, and presents preliminary interpretations.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the period November 1, 1984 to December 31, 1986***

AUTHORS: Groat, C G--**PROGRAM COORDINATOR**
PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 129
PUBLICATION DATE: September 1987
SPONSOR: DOE

REPORT OR CONTRACT#: DE-FC07-85NV10425
DESCRIPTORS: Water quality monitoring, Subsidence monitoring, and Microseismic monitoring

SCOPE:

This report describes environmental monitoring activities carried out by Louisiana State University (LSU) under U.S. Department of Energy Contract DE-FC07-85NV10425 for the period 1 November 1984 through 31 December 1986. This is a progress report in the sense that it discusses program components, provides raw data, and presents preliminary interpretations. The environmental monitoring program continues and will be the subject of subsequent annual reports.

TITLE: ***Technical Support For Geopressure-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the Period January 1,1987 to Nov.30, 1988***

AUTHORS: Groat, C.G.
PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 116
PUBLICATION DATE: November 1989
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10425
DESCRIPTORS: Microearthquake monitoring, Geological investigations, Water-quality monitoring, and Subsidence monitoring

SCOPE:

This report describes environmental monitoring activities carried out by Louisiana State University (LSU) under U.S. Department of Energy Contract DE-FC07-85NV10425 for the period 1 January 1987 through 30 November 1988. This report is a progress report in the sense that it discusses program components, provides data, and presents preliminary interpretations. The environmental monitoring and geological studies program continues and will be the subject of subsequent annual reports.

TITLE: ***Technical Support For Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the period 1 December 1988 to 31 December 1990***

AUTHORS: Groat, C. G. --**PROGRAM COORDINATOR**
PUBLISHER: Louisiana Geological Survey Louisiana State University

PAGINATION: 185
PUBLICATION DATE: July 1985
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-FC07-85NV10425
DESCRIPTORS: Microearthquakes monitoring, Subsidence monitoring, and Hulin Prospect Geology

SCOPE:

This report describes environmental activities carried out by Louisiana State University (LSU) under U.S. Department of Energy Contract DE-FC07-85NV10425 for the period 1 December 1988 through 31 December 1990. During the contract period, the Louisiana Geological Survey monitored microseismic activity, and land surface subsidence at three designed geopressured-geothermal test well sites in Louisiana and Texas. Geologic studies around well sites also continued. In addition, preliminary co-location studies of heavy oil occurrences together with geopressured-geothermal fluids in Louisiana were initiated. This report is a progress report in the sense that it discusses program components, provides data, and presents preliminary interpretations.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the period 1 January 1991 to December 31 1991***

AUTHORS: Groat, C.G., Chacko John, Bridget Jensen, and Dianne Lindstedt
.PUBLISHER: Louisiana Geological Survey Louisiana State University
PAGINATION: 123
PUBLICATION DATE: October 1992
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10425
DESCRIPTORS: Microearthquake monitoring, Subsidence monitoring, Co-locaation of medium-to-heavy oil fields, and Geopressured-geothermal resource

SCOPE:

Since September 1978, microseismic networks have operated continuously around U.S. Department of Energy (DOE) geopressured-geothermal well sites to monitor any microearthquake activity in the well vicinity. Microseismic monitoring is necessary before flow testing at a well site to establish the level of local background seismicity. Once flow testing has begun, well development may affect ground elevations and/or may activate growth faults, which are characteristic of the coastal region of southern Louisiana and southeastern Texas where these geopressured-geothermal wells are located. The microseismic networks are designed to detect small-scale local earthquakes indicative of such fault activation. Even after flow testing has ceased, monitoring continues to assess any microearthquake activity delayed by the time dependence of stress migration within the earth. Current monitoring shows no microseismicity in the geopressured-geothermal prospect areas before,

during, or after flow testing.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Final Report for the period 1 January 1992 to 31 December 1993***

AUTHORS: Groat, C.G., Chacko John, and Bridget Jensen
PUBLISHER: Center for Coastal, Energy, and Environmental Resources Louisiana State University
PAGINATION: 65
PUBLICATION DATE: January 1994
SPONSOR: DOE
REPORT OR CONTRACT#: DE-FC07-85NV10425
DESCRIPTORS: Microearthquake monitoring, Geopressured-geothermal reservoir, and Subsidence monitoring

AUTHOR'S ABSTRACT:

The U.S. Department of Energy has operated continuous-recording, microearthquake monitoring networks at geopressured-geothermal test well sites since 1980. These microseismic networks were designed to detect microearthquakes indicative of fault activation and/or subsidence that can potentially result from the deep subsurface withdrawal and underground disposal of large volumes of brine during well testing. Seismic networks were established before the beginning of testing to obtain background levels of seismicity. Monitoring continued during testing and for some time after cessation of flow testing to assess any delayed microseismicity caused by the time dependence of stress migration within the earth. No flow testing has been done at the Hulin well since January 1990, and the Pleasant Bayou well has been shut down since September 1992. Microseismic monitoring continued at the Hulin and Pleasant Bayou sites until 31 December 1992, at which time both operations were shut down and field sites dismantled. During 1992, the networks recorded seismic signals from earthquakes, sonic booms, geophysical blasting, thunderstorms, etc. However, as in previous years, no local microseismic activity attributable to geopressured-geothermal well testing was recorded.

TITLE: ***The Economics of Producing Methane From Geopressured Aquifers Along the Gulf Coast***

AUTHORS: Doscher, Todd M., R.H. Osborne, T. Wilson, S.W. Rhee, and Energy Consulting Associates
PUBLISHER: Department of Petroleum Engineering University of Southern California
PAGINATION: 69

PUBLICATION DATE: March 1978
SPONSOR: U.S. Energy Research and Development Administration
REPORT OR CONTRACT#: EY-76-5-03-0113
DESCRIPTORS: Well productivity, Selling price of methane, Reservoir parameters of geopressured aquifers, Injection cost, and Capital cost

SCOPE:

The purpose of this report was to estimate the cost of producing methane (natural gas) from geopressured aquifers inland from and along the coast of the Gulf of New Mexico. No other economic values of the geopressured brines were considered for exploitation.

There were several component tasks of such an overall analysis which had to be completed in order to arrive at the final conclusion.

1. An estimate of the reservoir parameters of the geopressured aquifers; their areal extent, net thickness of productive sand, porosity, permeability, effective compressibility. It is these parameters which determine the production rates and the total recovery of the resource that may be expected within an economic time frame.
2. An estimate of the production rates and cumulative production of geopressured aquifers having reservoir properties falling into the range of values that may be anticipated from the results of the first task.
3. An estimate of the operating and capital costs of drilling wells and producing such geopressured aquifers, An integral and significant part of the operating costs is the cost of disposing of the large quantities of produced brines following the desorption of the methane.
4. An estimate of the sales price of the recovered methane using appropriate discount rates.

TITLE: ***The Feasibility of Hydraulic Energy Recovery From Geopressured-Geothermal Resources***

AUTHORS: Thurston, Glenn C. and Martin M. Plum
PUBLISHER: Idaho National Engineering Laboratory EG&G
PAGINATION: 31
PUBLICATION DATE: September 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Expansion device, Application considerations, and Pelton turbine

AUTHOR'S ABSTRACT:

This report presents the results of a study conducted by the Idaho National Engineering Laboratory (INEL) for the Department of Energy (DOE) on the application of hydraulic energy recovery from geopressured-geothermal resources. The report examines both the technical and economic feasibility. Previous reports and demonstrations of geopressured-geothermal energy have been directed to the recovery of heat and methane. This report is specifically directed to extracting the pressure component of a typical reservoir. The pressure energy available in a 2200 psia

geopressured fluid could yield 1.49 W-h per pound and an average well could produce 500 kW. The best available device for recovering this energy is a Pelton turbine. Commercial Pelton turbines are not available for this application but are technically feasible. Suitable turbines could be developed with first of a kind engineering and tooling costs of approximately $227,000. The breakeven cost to add conversion of hydraulic energy to an existing methane/heat recovery system would be $0.030 per kWh based on a 10 year lifetime. Development testing is necessary to understand the effect of the dissolved gases, verify cavitation suppression, and materials selection. Cavitation suppression would be provided by utilizing the gas backpressure of the dissolved methane and carbon dioxide that exists in the geofluid.

It is estimated that adding conversion of hydraulic energy to an operating system recovering heat and methane could reduce the overall cost of electrical production by about 1.5 cents per kWh. This is not a viable stand-alone system if the well costs are to be born by the conversion of hydraulic energy alone.

TITLE: ***The Feasibility of Applying Geopressured-Geothermal Resources to Direct Uses***

AUTHORS: Lunis, Ben C., Jane Negus-de Wys, Martin M. Plum, Paul J. Lienau, F. J. Spencer, and George F. Nitschke
PUBLISHER: Idaho National Engineering Laboratory
PAGINATION: 113
PUBLICATION DATE: September 1991
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-761D01570
DESCRIPTORS: Hydrothermal-geothermal developments, Geopressured resource, Geopressured developments, and Economic considerations

AUTHOR'S ABSTRACT:

This study concludes that direct use technologies, especially desalinated water production, can contribute significantly to the value added process and the overall economic viability in developing a geopressured resource. Although agriculture and aquaculture applications are marginal projects when they are the only use of a geopressured well, the small margin of profitability can contribute to improving the overall economics of the direct use development. The added complexity from a technical and management aspect may add to the overall risk and unpredictability of the project.

Six combinations of direct uses received economic evaluation that resulted in 15% discounted payback periods ranging from 4 to over 10 years. These are listed in Table 4. Many other combinations are possible depending on the resource and market variables. Selection of appropriate technologies and sizes of applications will be established by the developer that engages in geopressured resource utilization.

Currently, many areas of the country where geopressured resources are located also have surplus electrical capacity and generation, thus power utilities have been selling power for less than 2 cents per kWH, well below a reasonable breakeven value for geopressured produced electricity. However, when the energy demand of the integrated geopressured facility is large enough to install power generation equipment, operating expenses can be reduced by not paying the 10 to 12 cents per kWH

utility rate.

The study includes an analysis of a geothermal turbine unit installed with a desalination and an agriculture/aquaculture facility, taking advantage of the cascading energy values. Results suggest that this scenario becomes profitable only where the market price for electricity exceeds five cents per kWH.

TITLE: ***The Feasibility of Recovering Medium to Heavy Oil Using Geopressured-Geothermal Fluids***

AUTHORS: Negus-de Wys, Jane, George F. Hart, Charles E. Kimmell, and Martin M. Plum

PUBLISHER: Idaho National Engineering Laboratory EG&G

PAGINATION: 107

PUBLICATION DATE: September 1991

SPONSOR: DOE

REPORT OR CONTRACT#: DE-AC07-76ID01570

DESCRIPTORS: Methods of thermal recovery, Thermal enhanced oil recovery, and Economic analysis

AUTHOR'S ABSTRACT:

The feasibility, economics and environmental concerns of producing more domestic oil using thermal enhanced oil recovery (TEOR) are reviewed and the unique nature of geopressured-geothermal (GPGT) fluids for thermal recovery are outlined. Current methods of TEOR are briefly discussed and it is noted that these methods are presently under scrutiny by both federal and state air quality agencies; and moreover, they often involve costly operational and mechanical problems associated with heating water on the surface for injection into the target reservoir.

The characteristics of the GPGT resources as seen through previous Department of Energy (DOE) studies from sites in Louisiana and Texas are discussed. These studies indicate sufficient quantities of GPGT fluids can be produced to sustain a TEOR project. The Gladys McCall Well can produce 25,000 to 40,000 bpd for 5 to 7 years at temperatures of about 275°F (135°C). The reservoir pressure is 12,784 psia and the brine chlorinity 57,000 mg/L with a total dissolved solids (TDS) content of 95,000 mg/L. Dissolved gas was about 25 scf/bbl of water. The Pleasant Bayou Well demonstrated similar temperatures, pressures (11,000 psi), salinity (70,000 mg/L), dissolved gas, and water production life but the TDS content was higher (127,000 mg/L). The Hulin Well showed higher temperature (300 - 375°F; 149 - 191°C) total dissolved solids of 195,000 mg/L and a gas content of about 34 scf/bbl. The chlorinity was 11,000 mg/L and the shut-in wellhead pressure was 7,200 psi. The Pleasant Bayou Well suggests that practical production rates of <20,000 bpd can avoid sanding problems.

The Alworth Field in the south Texas Mirando Trend is proposed as a TEOR pilot site. The temperatures of the Upper Wilcox GPGT fluids in this region range from 350 to >500°F (177 to >260°C), and salinities are in the range of 3,600 to 70,000 mg/L. The pressures are from 1000 to 3,500 psia flowing wellhead pressure. The target reservoirs for injection of the GPGT fluids are the Jackson and Yegua sandstones of the upper Eocene Epoch. These reservoirs contain an estimated

4 MMbbls of heavy oil in place (OIP) (18.6°API) of which it is estimated that at least 1 MMbbls could be recovered by TEOR. Assuming a conservative 80 scf/bbl gas content of the brine and with temperatures of 350- 500°F (177 - 260°C), 3,500 mg\L TDS, and a recovery of 1,000,000 bbls of crude, a conservative cash flow estimate is $6,270,928 per year. Similar estimates can be made for other areas of Texas, Louisiana, and California.

The problems associated with using the GPGT fluids for TEOR include those normally associated with hot water flooding but in addition the reaction of the brine from the geopressured-geothermal reservoir with the target reservoir is uncertain. Under the elevated temperatures associated with GPGT TEOR, actual increased porosity and permeability are possible due to density changes in the clay minerals (smectite to analcime), and associated silica dissolution and thermal decomposition of iron minerals (pyrite and siderite). Estimates by industry of the oil in place and an economic analysis of the TEOR process indicate the great value of the method if it can be successfully implemented.

TITLE: ***The Variable Pressure Supercritical Rankine Cycle for Integrated Natural Gas and Power Production From the Geopressured Geothermal Resource***

AUTHORS: Goldsberry, Fred L.
PUBLISHER: U. S. Department of Energy Geothermal Energy
PAGINATION: 44
PUBLICATION DATE: March 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DE82008937
DESCRIPTORS: Geopressured-geothermal resource, Power cycle, Working fluid, Supercritical propane, Subcritical isobutane, and Variable pressure supercritical rankine cycle

AUTHOR'S ABSTRACT:

The purpose of this paper is to describe a small-scale power plant cycle that utilizes both a variable pressure vaporizer (heater) and a floating pressure (and temperature) air-cooled condenser. Further, it defends this choice on the basis of classical thermodynamics and minimum capital cost by supporting these conclusions with actual comparative examples. The application suggested is for the geopressured-geothermal resource, The arguments cited in this application apply to any process (petrochemical, nuclear, etc.) involving waste heat recovery.

TITLE: ***Thermodynamic Analysis of a Geopressured Geothermal Hybrid Wellhead Power System***

AUTHORS: Chang, Ing and John R. Williams
PUBLISHER: Prairie View A&M University

PAGINATION: 66
PUBLICATION DATE: 1983
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AS08-83NV10355
DESCRIPTORS: EPRI geopressured wellhead power system, Gas engine-topped single-flash system, Gas engine -topped double-flash, and Binary system

SCOPE:

This research project is designed to evaluate the performance and operating characteristics of hybrid power cycles applied to geopressured and geothermal resources. The power systems evaluated are from the EPRI geopressured wellhead project and data used for the analysis are from the Pleasant Bayou well site.

Preliminary design considerations indicate that hybrid power cycles utilizing heat, methane gas and hydraulic energy from the reservoir should be the preferred method of developing power from geopressured resources. Also, EPRI anticipates that combustion hydrothermal hybrid cycles, without the pressure recovery component, can be applied in the development of hydrothermal reservoirs for power generation. The performance of the pressure reducing component is not included in this thermodynamic analysis.

Three types of hybrid power systems are analyzed thermodynamically in this project. They are (A) the single flash system, (B) the double flash system, and (C) the binary system. The studies of the first two systems are more extensive than the third one, although the binary system is the one chosen for testing at the Pleasant Bayou well site.

TITLE: ***The Geopressured -Geothermal Program: Energy Conservation Status and Future Possibilities***

AUTHORS: Negus-De-Wys, J., T. W. Lawford, and D. D. Faulder
PUBLISHER: Idaho National Engineering Laboratory
PAGINATION: 14
PUBLICATION DATE: 1989
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Geological setting, Well and brine characteristics, Hybrid power system, Process equipment, Thermal effects, Mechanical integrity, and Corrosion

AUTHOR'S ABSTRACT:

The Geopressured-Geothermal Program, sponsored by the Department of Energy (DOE) began

in 1976 with the Wells of Opportunity. This early research concentrated on resource characterization at several locations in Texas and Louisiana. More recently, the program has included well operations and supporting university research in geoscience and engineering. Long term flow testing, reinjection of brine, and scale prevention were accomplished et the Gladys McCall Well. The Pleasant Bayou Well provided additional data for modeling and predicting geopressured reservoir behavior. This year a hybrid power system (HPS) was constructed at Pleasant Bayou in cooperation with the Electric Power Research Institute (EPRI). This is the first conversion of the geopressured-geothermal resource to electricity. An economic review of geopressured-geothermal resource development concludes that using off-the-shelf technology, electricity can be produced for $0.125/kWh from a Gladys McCall type resource (40,000 bpd brine production, 27 scf methane/bbl, 288°F brine, and 10-year resource life). The Pleasant Bayou type resource can produce electricity for $0.32/kWh. Advanced technology could reduce the cost to $0.16/kWh.

A review and status of the HPS is presented with future possibilities for the program, including 1) recovery of medium and heavy oil with hot geopressured brine, 2) direct use, especially aquaculture, sod 3) development and use of advanced technology for conversion at the Hulin Well, the deepest, hottest well in the program. The estimated improvement in efficiencies with advanced conversion technology range from 100 to 160%. This would greatly reduce the cost to produce electricity.

TITLE: ***Thermal Conductivity of Aqueous NaCl Solutions from 20° C to 330° C***

AUTHORS: Ozbek, Huseyin and Sidney L. Phillips
PUBLISHER: Lawrence Berkeley Laboratory University of California
PAGINATION: 22
PUBLICATION DATE: May 1979
SPONSOR: DOE
REPORT OR CONTRACT#: W-7405-ENG-48
DESCRIPTORS: Thermal conductivity

AUTHOR'S ABSTACT:

An evaluation of published data on the thermal conductivity of aqueous NaCl solutions is presented. The literature was screened from 1929 through 1979, and the evaluated data were tabulated. The data were converted where necessary to a set of internally consistent units of °C, watts/m-°C and molal concentrations. An empirical correlation equation with an average deviation of +2% is given for the thermal conductivity of aqueous NaCl solutions from 20°C to 330°C at saturation pressures. A table of smoothed values generated using this correlation equation is provided for NaCl concentrations between 0 and 5 molal over this temperature range.

TITLE: ***Thermodynamics of Geothermal Brines I***

SUBTITLE: ***Thermodynamic Properties of Vapor saturated NaCl (aq) Solutions From 0-300° C***

AUTHORS: Silvester, Leonard F., Kenneth S. Pitzer, and Energy and Environmental Divison Laurence Berkeley Labortories
PUBLISHER: Lawrence Berkeley Laboratory University of California
PAGINATION: 62
PUBLICATION DATE: January 1976
SPONSOR: U.S. Energy Research and Development Administration
REPORT OR CONTRACT#: W-7405-ENG-48
DESCRIPTORS: Excess thermodynamic quantities, Gibbs energy, Enthalpy, Entropy, and Heat capacity

AUTHOR'S ABSTRACT:

Osmotic and activity coefficient data, enthalpy data, and heat capacity data on aqueous sodium chloride solutions from various sources have been fitted to a thirteen parameter equation. The equation reproduces the osmotic coefficient data to +0.005 over the composition range 0-6 M and temperature range 0-300°C, enthalpy data to +5-10 cal/mole for compositions of 0-5 M at temperatures from 25-100°C, and heat capacity data to +0.5 cal/°K for compositions of 0-2 M at temperatures from 25-200°C. Tabulated values of the total Gibbs energy, enthalpy, and heat capacity, plus partial molal and excess thermodynamic quantities of sodium chloride solutions for compositions of 0-6 M at 25°C intervals from 0-300°C are given along with the same quantities in graphical form for compositions of 0-6 M at temperatures of 100-350°C.

TITLE: ***Third Symposium on Abnormal Subsurface Pore Pressure***

AUTHORS: not given
PUBLISHER: Department of Petroleum Engineering and School of Geoscience Louisiana State University
PAGINATION: 173
PUBLICATION DATE: May 1972
SPONSOR: Department of Petroleum Engineering and School of Geoscience Louisiana State University
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

This is a collection of papers that were prepared for the Abnormal Subsurface Pressure Symposium of the Society of Petroleum Engineers of AIME, held in Baton Rouge, La., May 15-16, 1972.

TITLE: ***Testing of Pleasant Bayou No. 2***

AUTHORS: Rodgers, John A.
PUBLISHER: Gruy Federal, Inc.
PAGINATION: 55
PUBLICATION DATE: February 1981
SPONSOR: DOE and Fenix & Scisson
REPORT OR CONTRACT#: SC-PB-80-374
DESCRIPTORS: Phase I and Prognosis for Phase II

AUTHOR'S ABSTRACT:

Phase I production testing of the geothermal-geopressured reservoir of Pleasant Bayou No. 2 (14,630 to 14,704, Figure 1), Brazoria County, Texas was completed on October 31, 1980. The well was closed in and the pressure buildup recorded until December 15, 1980. Test results of production and pressure studies indicate the following:

Initial bottomhole pressure was	11,116.28 psia
Bottomhole temperature	301°F
Permeability	159.8 md
Fluid viscosity	0.365 cp
Skin factor	+7
Areal extent of the reservoir	<36,000 acres
Produced brine temperature	277°F
Gas brine ratio	22.0/1
Gas - % methane	87
Dissolved solids in brine, ppm	130,000
Calcium ppm	9 ,000
Chloride ppm	79,000
Sodium ppm	38,000
Total hardness, MG CaC03/L	28,000

TITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***
SUBTITLE: ***Detailed Completion Prognosis For Geopressured- Geothermal Wells of Opportunity Prospect #7 Pauline Kraft Well No.1***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 153
PUBLICATION DATE: not given
SPONSOR: DOE

REPORT OR CONTRACT#: DE-AC08ET-27081
DESCRIPTORS: Legal agreements, Management plan, Deliverables, Re-entry and completion operations, Drilling operations, Surface production, Plug and abandonment, and Environmental information

SCOPE:

This report describes the re-entry and completion procedures for the Pauline Kraft No. 1 test well. A description of the location and geology are also included in this report.

TITLE: ***Testing Geopressured Geothermal Reservoirs in Existing Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal well of Opportunity Prospect #7 C and K Frank A. Godchaux III, Well No.1***

AUTHORS: not given
PUBLISHER: Eaton Operation Company, Inc.
PAGINATION: 184
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Management plan, Deliverables, Location, Re-entry and completion operations, Plug and abandonment operations, and Environmental information

SCOPE:

This book is a detailed prognosis covering the acquisition, completion, drilling, testing and abandonment of Frank A. Godchaux, III, Well No. 1 under the Wells of Opportunity Program.

TITLE: Testing Geopressured-Geothermal Reservoirs in Existing Wells
SUBTITLE: Detailed Completion Prognosis For Geopressured-Geothermal Well of Opportunity Prospect #1 Clovis A. Kennedy No.1 Well

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 34
PUBLICATION DATE: April 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-AC08-80ET-27082
DESCRIPTORS: Geology, Test well procedure, Disposal well, Cost analysis, Fluid sampling and Environmental information

SCOPE:

This report is a detailed prognosis covering the acquisition, completion, drilling, testing, and abandonment of Clovis A. Kennedy No. 1 Well.

TITLE: ***Testing Geopressured-Geothermal Reservoirs in Existing Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal Program Well of Opportunity Prospect #2 Martin-Crown Zellerbach Well No. 2***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 201
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC008-80ET-27081
DESCRIPTORS: Management plan, Deliverables, Location, Re-entry and completion operations, Well test, Plug and abandonment, and Environmental information

SCOPE:

This report is a detailed prognosis covering the acquisition, completion, drilling, testing, and abandonment of Martin-Crown Zellerbach Well No. 2.

TITLE: ***Testing Geopressured-Geothermal Reservoirs in Existing Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured-Geothermal Program Prospect #6 HO&M Prairie Canal CO. Inc Well # 1***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 163
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Management plan, Deliverables, Location, Re-entry and completion, Well test, Plug and abandonment, and Environmental information

SCOPE:

This book is a detailed prognosis covering the acquisition, completion, drilling, testing and abandonment of the Prairie Canal Company, Inc. Well No. 1 under the Well of Opportunity Program.

The well is located approximately 10 miles south of the City of Lake Charles, Louisiana. Eaton Operating Company proposes to test a section of the Hackberry sand at a depth ranging from 14,976 to 15,024 feet. The reservoir pressure is estimated to be 13,516 psi and the temperature of the formation water is expected to be 304 F. The water salinity is calculated to be 27,000 ppm. The well is expected to produce 20,000 barrels of water per day with a gas content of 53 standard cubic feet per barrel.

TITLE: ***Testing Geopressured-Geothermal Reservoirs in Existing Wells***
SUBTITLE: ***Detailed Completion Prognosis for Geopressured -Geothermal Well of Opportunity Prospect #3 Wainoco P.R. Girouard Well No. 1***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 142
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Management plan, Deliverables, Location, Re-entry and completion, Well test, Plug and abandonment, and Environmental information

SCOPE:

This report is a detailed prognosis covering the acquisition, completion, drilling, testing, and abandonment of Wainoco P.R. Girouard Well No.1.

TITLE: ***Testing Plan (NUO-229) Addendum I T-F&S/Doe Gladys McCall No. 1 Well***
SUBTITLE: ***Phase II Reservoir Limit Determination Test of Sand Zone No. (15,508-15,636 feet)***

AUTHORS: not given
PUBLISHER: Technadril Fenix & Scisson
PAGINATION: 18
PUBLICATION DATE: March 1983
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Wellhead instrumentation and surveillance, Reservoir limit test, and Analytical testing and measurements

SCOPE:

The purpose of Phase II testing is to determine various reservoir parameters (permeability, skin, completion efficiency, hydraulic capacity, etc.) and the reservoir limits or boundaries associated with Sand Zone No. 9 (refer to Figure 1), as well as to characterize analytically the production brine and gas and measure gas/water ratios. This testing will be accomplished through a conventional reservoir drawdown test at a brine production rate of 6,000 B/D with the brine/gas separator operating at 700 psig, followed by a conventional reservoir pressure buildup test.

It is expected that this limit test may require up to thirty days or even longer to complete; however, it is also expected that substantial information pertaining to the reservoir and its capabilities will be obtained during the first seven to fourteen days of the test. The actual duration of the test will be determined by evaluation of data obtained during the test.

It is important to note that this reservoir limit determination test will be conducted with a small leak existing in the seal assembly at 13,922 feet, resulting in communication between the 5-inch production tubing string and the 5 X 7-inch tubing/casing annulus. A major purpose of this addendum to the Testing Plan is therefore to describe in detail the surveillance systems that will be used to monitor very closely this leak situation, to present operational guideline information with respect to expected conditions as the limit test proceeds given the existing leak, and to present criteria that will be utilized to reach decisions to either shut-in the well and discontinue the limit test and/or to "kill" the well, should this drastic action become necessary.

TITLE: ***The Possible Impact of the Geopressure Resource on Conventional Oil and Gas Exploration***

AUTHORS: Quitzau, Robert and Zaki Bassiouni
PUBLISHER: Society of Petroleum Engineers of AIME
PAGINATION: 2
PUBLICATION DATE: 1981
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured aquifers and Monte Carlo simulation

AUTHOR'S ABSTRACT:

Gulf Coast Geopressured aquifers are thought to contain large amounts of dissolved gas. Although the total amount of geopressured water may be considerable, this resource is still considered marginal because of the low solubility of gas in water.

A calculation technique was developed to evaluate the economic potential of a geopressured aquifer for numerous conditions that could allow the exploitation of this unconventional gas resource. This technique allows for the consideration of both wells drilled with the sole intent of producing the geopressured resource and unsuccessful conventional hydrocarbon wells completed in geopressured intervals. The calculation technique allows also for the consideration of different water disposal methods and different taxation schemes.

The net present value of a prospect is used as the parameter to measure economic potential. Net present value is calculated as a function of gas price. Monte Carlo simulation is used to account for the uncertainty of the many parameters necessary to calculate net present value.

The calculation technique was applied to a typical Gulf Coast geopressured aquifer. From this application it is apparent that for certain likely conditions the conversion of an unsuccessful conventional hydrocarbon well into a geopressured brine well is economically feasible provided that any associated environmental and legal problems are overcome.

TITLE: ***The Possible Impact of the Geopressured Energy Resource on Conventional Oil and Gas Exploration***

AUTHORS: Quitzau, Robert and Zaki Bassiouni
PUBLISHER: Society of Petroleum Engineers of AIME
PAGINATION: not given
PUBLICATION DATE: 1981
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured aquifers, Surface disposal, Reijection, and Economic potential

AUTHOR'S ABSTRACT:

Gulf Coast geopressured aquifers are thought to contain large amounts of dissolved gas. Although the total amount of gas in solution may be great, this resource is considered marginal because the amount of gas per barrel of water is small.

A calculation technique was developed to evaluate the economic potential of a geopressured prospect for numerous conditions that could allow aquifer production by a company. This technique allows a choice from three different situations in which a well could become a geopressured water producer, three different disposal methods, and two different tax schemes.

The net present value of a prospect is used as the parameter to measure economic potential. Net present value is calculated as a function of gas price. The maximum water flow rate for a constant surface pressure is considered in the calculation technique. Monte Carlo simulation is used to account for the uncertainty of the many parameters necessary to calculate net present value.

The calculation technique was incorporated into a computer program and was applied to the Southeast Pecan Island prospect, a typical Gulf Coast geopressured aquifer.

From this application it is apparent that for certain conditions the conversion of an unsuccessful conventional hydrocarbon well into a-geopressured brine well may be economically advantageous to a company. In the future, this option should be considered in the evaluation of conventional hydrocarbon prospects, provided that any associated environmental and legal problems are overcome.

TITLE: ***Thermal Enhanced Oil Recovery (TEOR) Using Geopressured-Geothermal Brine***

AUTHORS: not given
PUBLISHER: Idaho National Engineering Laboratory EG&G Idaho
PAGINATION: not given
PUBLICATION DATE: December 1989
SPONSOR: DOE Idaho Operations Office
REPORT OR CONTRACT#: DE-AC07-76ID01570
DESCRIPTORS: Thermal Enhanced Oil Recovery, Geological setting, Brine, and Geopressure resource

AUTHOR'S ABSTRACT:

This white paper presents a unique plan for an Oil Industry-DOE cost sharing research project for Thermal Enhanced Oil Recovery (TEOR) of medium and heavy oil using geopressured-geothermal brine. This technology would provide an environmentally clean method of recovery as opposed to the burning of crude oil or natural gas used widely by the industry, but presently under scrutiny by federal and state air quality agencies, as well as provide an alternative to the very expensive operational and mechanical problems associated with heating water on the surface for injection.

An example test reservoir is a shallow, small structural reservoir about 1-1/2 miles long by 1/2 mile wide. It is presently producing heavy oil (18.6 API gravity) from 5 wells, and is marginally economic. One of three nearby geopressured-geothermal wells could be re-entered and recompleted to supply about 400°F brine from 13-16,000 feet. This brine can be used to heat and drive the heavy oil. It is anticipated that about one million barrels of oil may be recovered by this project. Over 3 million barrels are estimated to be in place; only 2.7% of the oil in place has been produced.

TITLE: ***Technical Support for Geopressured-Geothermal Well Activities in Louisiana***
SUBTITLE: ***Annual Report for the period 1 November 1982 to 31 October 1983***

AUTHORS: Groat, C. G. --**PROGRAM COORDINATOR**
PUBLISHER: Louisiana State University Louisiana Geological Survey
PAGINATION: 164
PUBLICATION DATE: October 1984
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-81NV10174
DESCRIPTORS: Water Quality, Subsidence monitoring, and Microseismic monitoring

SCOPE:

This annual report describes environmental monitoring activities carried out by Louisiana State University under U.S. Department of Energy Contract DE-AC08-81NV10174 for the period 1 November 1982 through 31 October 1983. This report is a progress report in the sense that it discusses program components, provides data, and presents preliminary interpretations. The

monitoring program continues and will be the subject of subsequent annual reports.

TITLE: ***Technadril-Fenix & Scisson T-F&S/DOE Gladys McCall No. 1 Well Cameron Parish, Louisiana***
SUBTITLE: ***Reservoir Limit Test Data Sand Zone No. 8, (15,158-15490 ft) October 7-November 30, 1983***

AUTHORS: Reservoir Dynamics, Inc.
PUBLISHER: Reservoir Dynamics, Inc.
PAGINATION: 165
PUBLICATION DATE: 1983
SPONSOR: not given
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:
Data only.

TITLE: ***United States Gulf Coast Geopressured Geothermal Program Special Projects Research and Coordination Assistance***
SUBTITLE: ***Final Report for the Period December 1, 1978- October 30, 1980***

AUTHORS: Dorfman, Myron H. and Robert A. Morton
PUBLISHER: Center for Energy Studies and Bureau of Economic Geology University of Texas at Austin
PAGINATION: 187
PUBLICATION DATE: June 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DOE-AS05-76-ET 27020 and DE-AS05-76-ET 28466
DESCRIPTORS: Technical assistance, Legal research, and Special projects

SCOPE:
In 1975, the United States Energy Research and Development Administration awarded contracts for preliminary studies of the development of geopressured-geothermal energy underlying the United States Gulf Coast. Among these was a contract for a Management and Scope-of-Work Study with the Center for Energy Studies (CES) at The University of Texas at Austin.

The results and recommendations of these studies were presented at the Second Geopressured

Geothermal Energy Conference sponsored by DOE in Austin February 23-28, 1976, and were published as Volume 1, Summary and Future Projections, of the proceedings of that conference.

In addition to recommendations concerning future research and development, the document suggested the formation of a coordination assistance unit to assist DOE in the orderly development of the region's potential resource. It was suggested that this unit could interact with state and local agencies, maintain liaison with various industrial components that participate in the overall program, and disseminate results of research in each of the component areas; this unit would thereby serve to coordinate developing field research in the bi-state area so that a colloquy could be established which would incorporate all elements concerned with resource assessment, advanced reservoir research and technology, resource utilization, and legal, social, and environmental research into a meaningful, pragmatic, and cost-effective program. This approach would facilitate the DOE strategy of involvement of state and local agencies and industry in the total program so that as success was demonstrated, those entities could assume a greater portion of costs and risks inherent in the development of a new technology.

In the course of planning for establishment of this coordination assistance unit, it became obvious that the need for special projects research could be expected to arise from time to time as the overall research program progressed.

To fill its needs for coordination assistance and periodic special projects research, DOE in July, 1976, contracted with the Center for Energy Studies and the Bureau of Economic Geology (BEG) to perform these tasks. The CES and BEG have performed these tasks under various contracts and extensions since that time. This final report documents work for the period: December 1, 1978, through October 31, 1980. The elevant contract numbers for this period are: EY-76-S-05-5243, DE-AS05-76ET28466, and DE-AS05- 76-ET27020.

To the extent possible, the following sections of this report document the work performed in the sequence in which project tasks were specified in contract EY-76-S-05-5243. A few deviations from this sequence arise because (1) two contract extensions somewhat modified the December, 1978, description of project tasks and (2) unanticipated difficulties with the Brazoria County design wells deprived researchers of some of the data required for analyses contemplated in the December, 1978, task descriptions.

TITLE: ***U.S. Gulf Coast Geopressured-Geothermal Reservoir Simulation***
SUBTITLE: ***Final Report (Year 3)***

AUTHORS: MacDonald, R.C., H. Ohkuma, K. Sepehrnoori, and M.M. Chang
PUBLISHER: Center for Energy Studies
PAGINATION: 40
PUBLICATION DATE: not given
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC05-76ET28463
DESCRIPTORS: Model improvements, Reservoir mechanics, Mathematical description, Numerical approximation, and Reservoir performance prediction

SCOPE:

The purpose of the ongoing research performed for the Department of Energy's Geopressured Geothermal Division under contract with The University of Texas at Austin (UTA) is to develop reservoir modeling techniques to be used in conjunction with field data to estimate the long-term behavior of geopressured-geothermal reservoirs for various exploitation scenarios.

This report summarizes the work accomplished during the third year of this effort. Unfortunately, because of delays in the drilling, completion, and testing of the DOE's Pleasant Bayou #2 well (the first geopressured-geothermal "design" well), no significant field data were available to be incorporated into the work reported herein.

Chapter 2 of the report describes several reservoir model improvements incorporated into the UTA model during this, contract period. The most significant modification to the model was the inclusion of semi-implicit treatment of transmissibilities so as to better handle two-phase flow problems associated with flow near the wellbore. Chapter 2 also includes a description of the reservoir mechanics presumed operative in geopressured-geothermal reservoirs. A mathematical model describing two-phase two-dimensional flow in compacting porous media is developed from the Lagrangian point of view. Chapter 2 concludes with a description of the way the differential equations are approximated by finite differences and subsequently solved by means of numerical procedures.

Chapter 3 describes various sensitivity studies made with the reservoir model. Particular emphasis was given to the study of potential shale dewatering effects on reservoir depletion and the effects of compaction on fluid recovery. To study shale dewatering, the shale thickness and the shale vertical permeability were treated as variables in several simulation experiments. The effects of compaction were modeled with optimistic and pessimistic values for the uniaxial compaction coefficient in an attempt to define a region of expected reservoir performance. In this regard it must be emphasized that the results are to be treated as a range of possibilities rather than a definitive statement of recovery expectations since very few corroborative data are available from the geopressured-geothermal prospects. However, laboratory analysis of core samples obtained from the geopressured-geothermal test well was completed by the end of year 3. These data indicate that the uniaxial compaction coefficient is of the same order of magnitude as the pessimistic value used on the sensitivity studies. Because of this the expected fluid recovery from geopressured reservoirs has been reduced to a nominal 5% of the in-place volumes rather than the previously reported 10%.

During year 3 personnel from this research project participated in several joint meetings with operators, DOE representatives, and other researchers to discuss completion design well testing procedures and other matters related to the Pleasant Bayou $2 design well. Testing had not proceeded far enough to allow any meaningful interpretation of data.

Systems, Science, and Software, Inc. (SSS) has delivered a computer code to UTA in partial fulfillment of its subcontracting obligations to this project. Implementation of this code on UTA computer facilities has not been successful because of conversion problems from the SSS Univac Fortran used to develop the program s to the standard ANSI Fortran used at U T A.

TITLE: ***US Geothermal Energy Program Five Year Research Plan 1986-1990***
SUBTITLE: ***Energy From the Earth***

AUTHORS: not given
PUBLISHER: DOE
PAGINATION: 74
PUBLICATION DATE: July 1986
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geothermal Energy Technology, Geothermal R&D Strategy, Technical plan, Management Plan, and Outcome

SCOPE:

This document is the U.S. Department of Energy FY 1986 - FY 1990 Five- Year Research Plan for geothermal energy technologies. The Plan is intended to provide Federal and industry decision-makers an overview of the current status of geothermal resource recovery and conversion technology and of DOE research to improve these technologies.

The Plan is formulated within the policy principles of the National Energy Policy Plan (NEPP-V) to promote a balanced and mixed energy supply system and to maximize the practical reliance on the free decisions of the entire populace while maintaining public health, safety, and environmental quality.

The objectives of the DOE geothermal R&D program have been integrated with the objectives of the DOE R&D programs for other forms of renewable energy. This integration is documented in the DOE report, "Renewable Energy Research and Development Outlook," February 1985, and is described in this Plan.

The Geothermal Energy Research Program that is guided by this Plan consists of R&D activities whose objectives address a balance among short-term and long-term goals. The short-term goal is to achieve significant improvements in technical performance through research on second-generation technologies to extract and convert geothermal energy from liquid-dominated hydrothermal reservoirs. These improvements are expected to increase markedly the number of U.S. hydrothermal reservoirs from which industry can produce energy in the near term. The longer-term goal is to determine whether geopressured energy, hot dry rock, and magma are viable future energy sources and to provide a base for industry evaluation of the economics of producing and utilizing these forms of energy.

Taken together, these four types of geothermal energy sources and the scientific and technical improvements sought by the Program offer significant potential to contribute to the Nation's economic and energy security goals.

TITLE: ***U.S. Gulf Coast Geopressured - Geothermal Reservoir Simulation: Final Task Report (Year 4)***
SUBTITLE: ***Final Report for the Period 1 August 1979 - 31 July 1980***

AUTHORS: MacDonald, R. C., Kamy Sepehrnoori, and H. Ohkuma
PUBLISHER: Center for Energy Studies University of Texas at Austin

PAGINATION: 88
PUBLICATION DATE: October 1982
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-79-ET-27112
DESCRIPTORS: Geopressured-geothermal design well, Geopressured-geothermal reservoirs, and Engineering aspect

SCOPE:

This report describes the work that was performed for the Department of Energy's Geopressured-Geothermal Division under contract with The University of Texas at Austin. The purpose of this work is to develop methods for analyzing geothermal geopressured reservoir production behavior and to predict such behavior in the future given specific exploitation scenarios.

This report summarizes work accomplished during the fourth year of this effort. During this year production well test data became available from the DOE's Pleasant Bayou #2 design well. Two relatively short term test periods during this year provided the first in-situ data for analysis. The results of the analysis of this data are given in Chapter 2. As yet, test periods sufficiently long in duration to ascertain in-situ compaction and shale dewatering effects have not been experienced.

During the fourth contract year a study was made of the effects of reservoir heterogeneities on production behavior. In particular permeability distribution and faulting of the reservoir and were studied to determine the sensitivity of recovery to these parameters. The results of this work are presented in Chapters 3 and 4. In general, the results suggest that the permeability in the vicinity of the well is a significant factor in determining the life of the well. It follows that locating wells in high permeability areas is desirable. In addition, it was determined that faults occurring in the reservoir would have to be virtually sealing to have significant effect on recovery. This also suggests, as did the permeability study, that permeabilities remote from the well are rather unimportant in determining the life of a well. Of course, these results are based on the study of the Pleasant Bayou reservoir and cannot be applied to other situations without careful analysis.

Another study completed during the fourth contract year was that of the effect of gas buildup around a producing well. This work is reported in Chapter 4. Gas will evolve from solution as the pressure is reduced on the aquifer water. The pressure reduction is expected to be greatest around the producing well. As the gas evolves from the water flowing to the production well it becomes trapped until a critical or residual free gas saturation is attained. This gas saturation may impede the flow of water and thus lower the productivity of the well. The results of this study indicate that this mechanism may indeed cause productivity loss for reasonable relative permeability relationships. Roberts has obtained the necessary gas-water relative permeability measurements for immobile gas saturations and determined that the gas blockage effect may be of significance.

Finally, rock mechanics research has indicated that specimens obtained from the Pleasant Bayou well have a tendency to creep. This phenomenon indicates that the uniaxial compaction model now incorporated into the reservoir model may not be appropriate given the relative significance of compaction in the production behavior of a geopressured-geothermal reservoir.

TITLE: ***Utilization of Geopressured Resources in the Oxidation of Organic Waste in Supercritical Water Phase I Final Report***

AUTHORS: Diaz, Alexander F., Howard J. Herzog, and Jefferson W. Tester
PUBLISHER: Energy Laboratory Massachusetts Institute of Technology
PAGINATION: 180
PUBLICATION DATE: November 1992
SPONSOR: DOE and Sandia National Laboratories
REPORT OR CONTRACT#: 67-5791
DESCRIPTORS: Process flow, Mass and energy balances, Turbine, and INEL Study

SCOPE:

The MIT Energy Laboratory has been investigating the feasibility of detoxifying hazardous waste by co-processing the waste with methane-containing geopressured brine. This report describes the progress in doing the first phase of the project. The work follows initial investigations on this subject carried out at the Idaho National Engineering Laboratory (INEL).

TITLE: ***Utilization of Geothermal Energy for Methane Production***
SUBTITLE: ***Final Report***

AUTHORS: CH2M Hill
PUBLISHER: DOE
PAGINATION: 108
PUBLICATION DATE: July 1980
SPONSOR: DOE
REPORT OR CONTRACT#: AC51-79ET27230
DESCRIPTORS: Geological assessment, Engineering, and Environmental and institutional assessment

SCOPE:

The J. A. Albertson Land and Cattle Company owns and operates a cattle feedlot between Nyssa and Vale in Malheur County, Oregon. Previous investigations indicate the presence of subsurface geothermal water in this area.

The company is considering the development of an integrated system to utilize the geothermal resource for a bio-conversion plant. This integrated facility would use the manure from approximately 30,000 head of feedlot cattle as a feed stock for an anaerobic digestion plant.

Anaerobic digestion of manure produces methane gas which can serve as an energy source for numerous end uses. The process also produces a digester residue which can be fed to the cattle as a supplemental feed.

This final report summarizes CH2M Hill's findings on engineering design, geological assessment, environmental, economic, and institutional requirements of the proposed project.

TITLE: ***U.S. Department of Energy Geothermal Program Review VII "DOE Research & Development for the Geothermal Market Place"***
SUBTITLE: ***Abstracts and Biographies***

AUTHORS: DOE--**EDITORS**
PUBLISHER: DOE
PAGINATION: not given
PUBLICATION DATE: March 1989
SPONSOR: DOE
REPORT OR CONTRACT#: not given
DESCRIPTORS: N/A

SCOPE:

A collection of Geothermal abstracts and biographies.

TITLE: ***Use of Inhibitors for Scale Control in Brine-Producing Gas and Oil Wells***

AUTHORS: Tomson, M. B. , L. A. Rogers, K. Varughese, S. M. Prestwich, G. G. Waggett, and M. H. Salimi
PUBLISHER: Society of Petroleum Engineers
PAGINATION: 2
PUBLICATION DATE: October 1986
SPONSOR: Gas Research Institute and Department of Energy
REPORT OR CONTRACT#: not given
DESCRIPTORS: Geopressured-geothermal brine and Inhibitor

AUTHOR'S ABSTRACT:

Field and laboratory work sponsored by the Gas Research Institute (GRI) and the Department of Energy (DOE) have shown that calcium-carbonate scale formation in waters produced with natural gas and oil can be prevented by injection of phosphonate inhibitor into the formation, even if the formation is sandstone without calcite binding material. Inhibitor squeeze jobs have been carried out on DOE's geopressured-geothermal Gladys McCall brine-gas well and GRI's co-production wells in the Hitchcock field. Following the inhibitor squeeze on Gladys McCall, the well produced over five million barrels of water at a rate of approximately 30,000 BPD without calcium-carbonate scaling. Before the inhibitor squeeze, the well could not be produced above 15,000 BPD without significant scale formation. In the GRI brine-gas co-production field tests, inhibitor squeezes have been used to successfully prevent scaling.

Laboratory work has been conducted to determine what types of oil field waters are subject to scaling. This research has led to the development of a saturation index and accompanying

nomographs which allow prediction of when scale will develop into a problem in brine production.

Core samples from both fields were used in laboratory studies and analytical methods to analyze inhibitors in brine at a low levels were extended. A complete history of field developments and the laboratory backup experiments is included in this paper.

TITLE: ***Geopressured-Geothermal Program***
SUBTITLE: ***"Wells of Opportunity Program" Final Contract Report Testing Geopressured Geothermal Reservoirs in Existing Wells***

AUTHORS: not given
PUBLISHER: Eaton Operating Company, Inc.
PAGINATION: 270
PUBLICATION DATE: 1981
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC08-80ET-27081
DESCRIPTORS: Geology, Well test, Production, Design and operation, and Completion

SCOPE:

This report provides a comprehensive discussion of the test results preformed on the wells in the "Wells of Opportunity Program." The test results include data on reservoir performance, completion techniques, and fluid chemistry.

TITLE: ***Well Test Analysis and Reservoir Predictions for Geopressured Geothermal Systems (1979-1980)***
SUBTITLE: ***Final Report***

AUTHORS: Garg, S.K., J.W. Pritchett, L.F. Rice, and T.D. Riney
PUBLISHER: Systems, Science and Software
PAGINATION: 106
PUBLICATION DATE: September 1980
SPONSOR: DOE
REPORT OR CONTRACT#: DE-AC-08-79 ET 27202
DESCRIPTORS: Flow data, Reinjection of fluids, Shale recharge, and Production

AUTHOR'S ABSTRACT:

This final technical report describes the work performed by S^3 during the first year (1979-1980) of a continuing effort to analyze and interpret data generated from DOE-funded tests of

geopressured wells in the Texas-Louisiana Gulf Coast region. During this period S^3 has analyzed preliminary flow data from the Pleasant Bayou No. 2 well and used its MUSHRM simulator to perform predictive calculations for the planned long-term flow tests. These results are presented in Section II of this report. Sections III ana IV of the report describe the results of two generic studies of representative geopressured systems. In the first study (Section III), MUSHRMl was employed to examine the effects of reinjecting the processed brine on the long-term performance of a geopressured reservoir. The second study (Section IV) used MUSHRM to examine the potential fluid recharge that may be expected from neighboring shale layers as geopressured fluid is produced from interbedded sands. Finally, the modifications made in the S^3 simulation techniques are summarized in Appendix B.

TITLE: ***Well Test Analysis and Improve Models For Geopressured-Geothermal Systems***
SUBTITLE: ***Final Report Sept 1, 1985-Dec 31, 1990***

AUTHORS: Riney, T.D.
PUBLISHER: S-Cubed
PAGINATION: N/A
PUBLICATION DATE : 1991
SPONSOR: DOE and UTA
REPORT OR CONTRACT#: DE-FC07-85NV10412
DESCRIPTORS: N/A

SCOPE:

In accordance with the S-CUBED Subcontract Work Statement, S-CUBED has concentrated on the synthesis, correlation and analysis of all pertinent data from the Department of Energy (DOE) geopressured-geothermal research wells undergoing testing during the contract period. This work has included the development of reservoir simulation models for the geopressured-geothermal resource in hydrological connection with each well. Existing S-CUBED simulation techniques have been applied to develop, update and improve the models for the reservoirs tested. During the contract period, data have been available from the Gladys McCall, Pleasant Bayou and Hulin test wells. S-CUBED has also contributed to the design of the well tests and participated in DOE's planning and review meetings in support of the geopressured-geothermal program. Detailed technical Topical Reports have been prepared and issued as appropriate during the contract period as referenced in this summary of the work performed during the final year of the S-CUBED Subcontract to UTA.

TITLE: ***Well Test Analysis and Reservoir Modeling of Geopressured-Geothermal Systems***
SUBTITLE: ***Includes Topical Reports on Analyses for: Pleasant Bayou Well No.2 Gladys McCall Well No.1 Final Report***

AUTHORS: Riney, T.D. and L.A. Owusu
PUBLISHER: S-Cubed
PAGINATION: 127
PUBLICATION DATE: February 1993
SPONSOR: DOE and Lawrence Berkeley Laboratory
REPORT OR CONTRACT#: AE-AC03-76SF00098
DESCRIPTORS: Pleasant Bayou Well No. 2 and Gladys McCall Well No.1

SCOPE:

This report documents the reservoir analysis that was performed on both the Pleasant Bayou Well and Gladys McCall Well.
