Geopressured - Geothermal Drilling and Testing Plan

VOLUME II TESTING PLAN

DOW CHEMICAL CO. - DEPT. OF ENERGY
DOW-DOE SWEETZ NO. I WELL
VERMILION PARISH, LOUISIANA

FEBRUARY 1982

PREPARED BY THE DOW CHEMICAL CO.
under
CONTRACT No. DE-AC08-79ET27255

U. S. DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE
DOW CHEMICAL COMPANY

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DOW CHEMICAL U.S.A.

March 18, 1982

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U. S. Department of Energy
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Dear Mr. Jelacic:

Enclosed is a copy of the Testing Plan for
Dow/D.O.E. Sweezy No. 1 well.

Very truly yours,

John S. Wilson,
Project Manager

JSW:gfc

Enclosure

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ABSTRACT

The Dow/D.O.E. L. R. Sweezy No. 1 geo-pressured 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.

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I. INTRODUCTION

A. Objectives

The primary objective of this program is to determine the production characteristics of a definable and known geopressured water reservoir. Secondary objectives include observation of the changes in the nature of fluids as production proceeds; evaluation of procedures relative to the mechanisms of producing the fluids and accumulation of data to evaluate the economics of energy production from the resource.

The reservoir production characteristics which the program is designed to determine include:

1. Maximum attainable production rate under the conditions of the well and the reservoir.
2. Ultimate productivity of the reservoir over its practical productive life.
3. Reservoir pressure change as production proceeds and estimation of formation changes which occur.
4. Accumulation of baseline data for determination of parameters useful for calculations involving three-dimensional geopressured reservoir modeling.
5. Determination of possible contribution of shale water influx on reservoir productivity.
6. Nature and composition of the fluids produced and the changes which occur in the produced fluids as pressure drawdown occurs.

B. Program

The plan is to produce the reservoir through a series of short term drawdown and buildup tests followed by a long term production test. The latter is to continue until sufficient data has been developed to extrapolate the reservoir curve to depletion. A production period of six to nine months at 20,000 bbls/day is estimated to be required.

Particular attention will be paid to the changes in gas/water ratio as production proceeds and reservoir pressure falls. This is deemed an essential factor in the economic evaluation of the geopressured geothermal resource. This reservoir, being small and definable, should give a clear picture of the gas production potential over its productive life span, and thus an indication of expectations from a large reservoir.

C. Location

Details of the location, expected reservoir limits, and area geology are given in Section VII of this Testing Plan. Briefly, the well is located approximately eight miles south of the city of Lafayette, Louisiana in Vermilion Parish, Section 26, Township 11 south, Range 4 east.

II. ORGANIZATION AND MANAGEMENT STRUCTURE

A. General

This section identifies the organizations and principal personnel participating in the well drilling and testing program and describes basic authorities and responsibilities.

B. Organizations and Personnel

1. Department of Energy, Geothermal & Hydropower Technologies Division (GHTD) Washington, D.C.

Geopressure Program Manager -- G. Ellis

2. Department of Energy, Nevada Operations Office, Las Vegas, Nevada (DOE/NV)

- a. Director, Energy Applications Division -- J.Cotter

- b. Chief, Geothermal Branch -- R. Stearns

- c. Project Manager, Drilling -- J. Fiore

- d. Director, Geopressure Projects Office, Houston -- F. Goldsberry

- e. Project Manager, Testing -- F. Goldsberry

3. Dow Chemical Company, Midland, Michigan

- a. Contractor Project Manager -- J.S. Wilson

- b. Business Manager -- J.G. Stanley

- c. Technical Coordinator -- J.R. Hamilton

- d. Production Manager -- C.J. Pavlick

- e. Subcontractors to Dow

- (1) Surface Equipment & Production
Johnston-Macco (Schlumberger) -- D.Myren

- (2) Reservoir Measurements
Otis Engineering -- A.C. Istre

- (3) Reservoir Analyses
Otis Engineering -- L.E. Coble

- (4) Fluids Analyses
University of S.W. Louisiana -- J.R.Meriwether

(5) Fluid Recombination Studies
Weatherly Laboratories, Inc. --J. Ledlow

(6) Core Analyses
Terra Tek -- J.F. Schatz

4. Louisiana Geological Survey/Louisiana State University
 - a. Program Manager, Geological -- D. Bebout
 - b. Program Manager, Environmental -- C. Groat
5. University of Southwestern Louisiana
Principal Investigator -- G.L. Kinsland

C. Authorities and Responsibilities

Responsibilities of the participating organizations are summarized as follows:

1. Geothermal & Hydropower Technologies Division (GHTD)

Identify overall program objectives, provide funding and authorization, and designate a Geopressure Program Manager with the following authorities and responsibilities;

- a. Approve any major changes to the approved well testing plan.
- b. Provide an approved Environmental Impact Assessment for the drilling and testing activities.
- c. Approve any proposed contract modifications which result in increased funding levels.
- d. Maintain continual cognizance of the well testing activities.

2. Nevada Operations Office (NV)

a. Geothermal Branch, Las Vegas, Nevada

- (1) Approve the Dow Chemical Company geopressure well testing plan.
- (2) Provide a Drilling Project Manager to maintain technical and administrative management of the project through receipt of oral and written reports and by on-site monitoring of critical project phases.

(3) Provide formal direction to the Contractor to assure compliance with contract provisions.

(4) Report project status to the Geopressure Program Manager.

b. Geopressure Project Office, Houston

(1) Review and evaluate the well testing progress and make recommendations to the DOE Contracting Officer.

(2) Provide the day-to-day interface with industry, states, and educational institutions to maintain effective channels of communications regarding the development of the geopressure energy resource.

(3) Provide a Testing Project Manager to maintain technical and administrative management of the project through the testing phase.

(4) Assist in the coordination between the well drilling and testing contractor, the Louisiana Geological Survey/Louisiana State University of Southwestern Louisiana.

(5) Prepare and coordinate press releases.

3. Dow Chemical Company

a. Prepare a detailed geopressure well testing plan for approval.

b. Conduct the well testing activities in accordance with the approved plan and the provisions of the Contract.

c. Coordinate testing activities with the Louisiana Geological Survey through the Nevada Operations Office.

d. Provide logistical and other support to the Louisiana Geological Survey and other participating research institutions, with approval of the Nevada Operations Office.

e. Prepare and submit reports as specified in Section IX of this plan and maintain a daily project cost status.

f. Inform NV of any proposed deviation from the approved drilling and testing plan before the deviation, if not an emergency, and immediately afterwards if an emergency.

4. Louisiana Geological Survey/Louisiana State University.

Provide geological analysis and environmental monitoring as specified in Section III of this plan.

5. University of Southwestern Louisiana

Obtain and interpret high resolution seismic data before and after production of geopressed fluids.

See Figure II-1 for relationship of primary organizations.

GEOPRESSURE WELL DRILLING & TESTING PROGRAM ORGANIZATION CHART

Figure 11-1

III. TASK DIAGRAM

The tasks for the principals involved are listed as follows:

A. The Dow Chemical Company & Subcontractors

- *9 Install and connect all surface equipment.
- **10. Lay gas pipeline and make connection.
- 12. Install Hewlett-Packard downhole pressure-temperature gauge.
- 13. Perform two week staged drawdown and buildup tests. Sample and analyze fluids. Determine feasibility and plan long-term production test.
- 14. Perform long-term production tests.
- 15. Sample fluids periodically at surface and analyze chemical and PVT properties of gas and water.
- 16. Monitor pressure and temperature at wellhead.
- 17. Shut in well periodically and run buildup test with Hewlett-Packard instrument.
- 18. Shut in well at end of test, recover 5- $\frac{1}{2}$ " tubing and inspect to assess effects of erosion and corrosion.
- 19. Plug and abandon well in accordance with State and Federal regulations. Restore site to original condition.
- 20. Evaluate and interpret data, prepare oral and written reports.

*NOTE: Tasks 1-8 & 11 - Volume 1, Drilling & Completion

**NOTE: Only if feasible and approved by D.O.E.

B. The Louisiana Geological Survey/Louisiana State University (LSU) - Environmental Studies

- 1. Environmental baseline and monitoring studies prior to fluid production including air quality, water quality, subsidence, seismicity and ecosystem quality.
- 2. Environmental monitoring during drilling phase including the above items.

3. Environmental monitoring during production phase including the same items.
4. Final report.

C. The University of Southwestern Louisiana (USL) High-Resolution Seismic Survey

1. Design 3-D seismic survey to study effects of pressure reduction in the reservoir.
2. Perform seismic survey prior to brine production.
3. Perform same survey after production is complete.
4. Analyze data.
5. Prepare reports.

D. United States Geological Survey (USGS) - Precision Geothermal Gradient Survey

1. Precision temperature log when well is drilled to total depth.
2. Similar temperature log after no production for at least two months, to allow temperature equilibrium.
3. Comparison of logs and analyses to determine true temperature gradient and correction factors.
4. Write reports.

The inter-relationships of these tasks by Dow, LSU, USL and USGS are shown in the Task Diagram, Figure III-1.

PARC PERDUE GEOPRESSED GEOTHERMAL PROJECT
TASK DIAGRAM

Figure III-1

DATE: 10-20-81

IV. TASK DESCRIPTIONS

The following is a description of the various tasks and the activities and sub-activities involved in the performance of these tasks. This detailed description is limited to the activities of the Dow Chemical Company and its subcontractors and does not include the supplementary efforts of other Department of Energy Contractors.

A. TASK NO. 9

ACTIVITY: Install and connect all surface equipment.

OBJECTIVE: Provide the equipment to flow the well, separate the gas and brine, inject the brine into the disposal well and collect all the pertinent data from the surface operation.

DESCRIPTION: The activities under this task can be divided into the following sub-activities:

1. Installation of the production, choke, flow-meter, separators, well clean-up system and the associated piping and valving- Johnston-Macco.
2. Installation of the gas handling system, gas clean up and flare- Johnston-Macco: Dow.
3. Installation of sensors to measure wellhead pressure and temperature, separator pressures and temperatures, gas flows, brine flows, and injection well pressure - Johnston-Macco: Otis: Dow.
4. Installation of data recording system - Otis.

The goals of these activities is to provide a system to receive the flow from the production well, control the flow rate, separate the gas from the brine, provide a gas flow for sales, re-inject the brine into the disposal well and to measure all the quantities, pressures and temperatures involved. A portion of this equipment will be installed while the disposal well is being drilled. This would include all the equipment from the tree through the choke and a line to the 20,000 bbls. lined salt water storage pit to allow short term flowing of the well.

*NOTE: Tasks 1 thru 8 and Task 11 detailed in Volume 1, Drilling and Completion.

B. TASK NO. 10 *

ACTIVITY: Lay gas pipeline and make connections.

OBJECTIVE: Provide for the marketing of the produced gas as soon as possible.

DESCRIPTION: A preliminary arrangement has been made to market the gas to Texas Gas Transmission Corporation through a collection line some 1200 feet from the well site. The goal of this task is to provide a transmission line, expected to be a two inch line, to this collection system. The line will be installed through a pasture and will be entirely on the host landowners fee property. No roads or obstructions are present.

C. TASK NO. 12

ACTIVITY: Install Hewlett-Packard downhole pressure-temperature gauge.

OBJECTIVE: Provide a reliable pressure and temperature record of the bottom-hole for the short term testing and periodic values during the long term test.

DESCRIPTION: The Hewlett-Packard gauge will be located below the perforations to avoid turbulence. It will lock into an Otis "XN" Landing Nipple (2,205" ID) at 13,459 feet. A special corrosion resistant, armored cable, MP35N multiphase logging cable, will be used to prevent cable failure in turbulent flow up the production tubing. A nipple with a sleeve extending below the "Y" on the production tree will prevent cable damage at that point.

The landing nipple and the protective sleeve are in place. The activity under this task will consist of landing the gauge and locking it in place. The cable is spooled on a skid-mounted drum and will remain on the site for the entire program.

Signals from the down-hole gauge, taken simultaneously with readings from the surface measurements, will be recorded and also transmitted to Otis Engineering in Dallas, Texas via a dedicated phone line.

* Contingent upon feasibility and D.O.E. approval.

D. TASK NO. 13

ACTIVITY: Perform two-week staged drawdown and buildup tests. Sample and analyze fluids, determine feasibility and plan long-term production test.

OBJECTIVE: Flow the well and collect production data for such a time period required to determine the reservoir parameters that may vary with flow rate or pressure changes due to gas.

DESCRIPTION: The sub-activities involved in this task consists of a clean-up flow period producing minimum of 400 bbls. of fluid, a shut-in period, and four variable rate isochronal drawdowns and buildups. Variables measured will be wellhead pressure, wellhead flow, pressure drop across flow meter, gas flow rate, water flow rate, bottom hole pressure and bottom hole temperature. Data from these test flows will be recorded and transmitted to Otis-Dallas.

E. TASK NO. 14

ACTIVITY: Perform long-term production test.

OBJECTIVE: The long-term test will be designed to determine aquifer performance over a relatively long period of flow. Items to be studied include effects of rock deformation, gas/water flows, aquifer boundaries and shale water influx. The total potential of the reservoir, in terms of both quantity and rate, to produce gas and water will be determined.

DESCRIPTION: The long-term test will consist of several extended flow periods interrupted by periodic short buildup intervals. Flow rates of up to 25,000 BBLS/day are expected. The same measurements made in the short-term testing will be used. However, downhole measurements will be made only during the buildup intervals.

F. TASK NO. 15

ACTIVITY: Sample fluids periodically at surface and analyze chemical and PVT properties of gas and water.

OBJECTIVE: The chemical composition of the gases and liquids produced will provide data to evaluate the economics of the resource and the influx of water from the surrounding shale. The PVT work will supply data on the physical

characteristics of the fluids at reservoir conditions. This data is essential for interpretation of reservoir behavior.

DESCRIPTION: The PVT work will be performed by Weatherly Laboratories. This consists essentially of the physical re-combination of the separator effluents at reservoir conditions to determine saturation pressure-vs-gas/water ratio curved and the physical properties of the reservoir fluids.

The chemical analyses will be performed primarily by personnel from the University of Southwestern Louisiana (ULS) with periodic checks by the Dow Laboratories in Freeport, Texas. Routine analyses will be done at the site in a fully equipped laboratory trailer. Special analyses will be performed at the University Laboratories in Lafayette, Louisiana.

G. TASK NO. 16

ACTIVITY: Monitor pressure and temperature at the wellhead.

OBJECTIVE: The wellhead pressure and temperature provide a guide to the production parameters of the reservoir as well as the data for the control of well flow rates.

DESCRIPTION: These measurements will be made by pressure and temperature sensors and will be continuously recorded on charts or electronic memory recorders depending on funds available.

H. TASK NO. 17

ACTIVITY: Shut in well periodically and run buildup test with Hewlett-Packard instrument.

OBJECTIVE: Measurement of bottom hole pressure and temperature is essential for determination of buildup rates and analysis of the reservoir parameters.

DESCRIPTION: The bottom hole measurements will be made with Hewlett-Packard pressure temperature gauge with surface readout capabilities. These measurements will be continuously recorded by Otis Engineering using a computerized system designed for this purpose. The signal from the computer will be transmitted to the Otis master computer in Dallas, Texas and used along with the other data for computerized reservoir modeling and analyses.

I. TASK NO. 18

ACTIVITY: Shut in well at end of test, recover and inspect 5½" tubing to assess effects of erosion and corrosion.

OBJECTIVE: The production tubing is coated with Tube Kote TK-2C. One of the objectives of the program is to gather information on the effectiveness of such coating to protect the underlying metal from erosion and corrosion.

DESCRIPTION: At the end of the test the well will be plugged at the production level. At that time, the production tubing will be recovered by pulling thru the polished bore receptacle. Each joint will be inspected for coating integrity, erosion and corrosion. This inspection will be as detailed as needed to evaluate the effects of the high fluid production rates on the tubing and to determine effective tubing life under such conditions.

J. TASK NO. 19

ACTIVITY: Plug and abandon well in accordance with State and Federal regulations. Restore site to original conditions.

OBJECTIVE: The well, being geopressured, must be plugged securely to prevent contamination of upper water sands by the geopressured brine. The site must also be restored to original conditions to satisfy possible landowner claims and provide normal land usefulness.

DESCRIPTION: All wells having no future utility shall, by Louisiana Statewide Order No. 29-B, page 23, be plugged within ninety (90) days from the date of inactive classification. Statewide Order No. 29-P, page 13, defines the plugging procedures to be used on geothermal wells. These procedures will be followed.

The site will be restored by disposing of all waters remaining in the pits, removing the pit lining, boards, and limestone pads. Fences will be removed and the site leveled, filling all ditches and pits. Finally, the entire site will be seeded with coastal bermuda grass to restore it to its original pasture condition.

K. TASK NO. 20

ACTIVITY: Evaluate and interpret data, prepare oral and written reports.

OBJECTIVE: Since the purpose of the program is to provide information to the nation on the feasibility of this resource, such written and oral reports as are deemed valuable will be prepared. These will include a final report.

DESCRIPTION: The dissemination of the information garnered from the program is the most important phase of this project. All subcontractors involved in the technical phases will prepare written reports of their conclusions including the data and reasoning involved. These subcontractors will also be given the opportunity to participate in oral presentations and/or publications involving the data.

A final report will be prepared summarizing all the data, calculations and conclusions. This and all other written or oral reports will be submitted to the U.S. Department of Energy for approval prior to publishing to the general public.

V. TESTING PROCEDURE SEQUENCE

Three tests are proposed to evaluate formation parameters.

A. CLEAN-UP TEST*

A clean-up test (optional), to be performed during well clean-up and before the disposal well is drilled, is recommended first. This test will flow water at high rates for short periods of time to achieve sufficient drawdown to produce a meaningful buildup curve, while minimizing the amount of water produced. Test procedure sequence follows:

1. Install test equipment to include: data header, choke, manifold, separator, (4) 210 bbl. tanks. Install lubricator and latch in Hewlett-Packard gauge in well.
2. Open choke valve and establish flow through separator.
3. Flow to tanks at rate of 7500 bpd. for 1 hour. record measurements, shut in well, strap tanks.
4. Record buildup curve until stabilized. Drain water to pit.
5. Open choke, flow to tanks at rate of 10,000 bpd. for one hour.
6. Shut in well, record measurements, strap tanks.
7. Record buildup curve until stabilized. Drain tanks.
8. Open choke, flow to tanks at rate of 12,500 bpd. for one hour.
9. Shut in well, record measurements, strap tanks.
10. Record buildup curve until stabilized. Drain tanks.
11. Analyze data.

NOTE:* Presently omitted from plans.

B. SHORT TERM TESTING

Short term testing will be done over a period of approximately two (2) weeks to provide detailed continuous down-hole measurements of pressure and temperature. Short term testing will establish all base line reservoir parameters. This testing includes a sequence of four variable rate isochronal drawdowns and buildups, and a pressure and temperature gradient survey, conducted in the following manner:

1. Install full complement of production equipment. Install automated data acquisition system to include output from flow meters (gas and liquid), wellhead pressure and temperature, and downhole pressure and temperature.
2. Install disposal well pressure/temperature gauge and recorder.
3. Open choke, flow at rate of 10,000 bpd. for 12 hours. Record all measurements according to recommended schedule.
4. Shut in well at wing valve for 12 hour buildup. Transmit data to Dallas every 4 hours for evaluation.
5. Obtain samples of gas and water during flow period.
6. Open choke, flow at rate of 15,000 bpd. for 12 hours. Record measurements and obtain samples.
7. Shut in well for 12 hour buildup.
8. Open choke, flow at rate of 20,000 bpd. for 12 hours. Record measurements and obtain samples.
9. Shut in well for 12 hour buildup.
10. Open choke, flow at rate of 25,000 bpd. for 12 hours. Record measurements and obtain samples.
11. Shut in well at wing valve for 96 hours (4 days) buildup.
12. Release gauge from Otis XN landing nipple.
13. Run pressure/temperature gradient survey while pulling out of hole. Stops to be made at T.D. (13,350'), 13,000', 12,000', 10,000', 5,000', 2,000', 1,000', 500', 200', lubricator.
14. Terminate test, rig down, analyze data.

C. LONG-TERM TESTING

The purpose of the long-term test is to achieve significant reservoir pressure depletion and evaluate reservoir properties under those conditions.

1. Install full complement of surface production equipment.
2. Open choke, flow at rate of 20,000 bpd. for 22 days actual flow rate to be optimized from analysis of short term test data.
3. Shut in well, run in H-P gauge, seat in Otis XN landing nipple run pressure buildup curve 2 days or until stabilized.
4. Repeat flow and shut in procedure.
5. Repeat flow and shut in procedure.
6. Repeat flow and shut in procedure.
7. Open choke, flow at rate of 20,000 bpd. for a period of 54 days.
8. Shut in well, run in H-P gauge, run pressure buildup curve 6.3 days or until stabilized.
9. Run pressure/temperature gradient survey coming out of hole after each buildup.
10. Rig down. Analyze data.

VI. PROJECT SCHEDULE

The contract between The Dow Chemical Company and the Department of Energy to drill and produce a geo-pressured well on the L.R. Sweezy lease site was signed on September 30, 1979. The program was planned to be completed within a twenty-four (24) month period. Various delays have extended the timing such that completion is now projected for February 28, 1983, or a time period of forty one (41) months.

The new schedule, with the estimated time for the performance of the various task groups, is shown in Fig. VI-1. This timing is dependent upon the schedule of funding during Fiscal Years 1982-1983. The extent of long-term testing required to give the desired reservoir data is estimated at eight (8) months. The results obtained as production proceeds may indicate either a shorter or longer test period. If such is the case, it is recommended that the schedule be modified as indicated by the data.

TIME SCHEDULE

PARCPERDUE RESERVOIR STUDY

DOW - D.O.E. L.R. SWEEZY NO.1

Figure VI-1

Revised 1/20 /82

TIME SCHEDULE - PARCPERDUE RESERVOIR TESTING - TASK PERFORMANCE

Figure VI-1a

VII. TEST DESCRIPTION

A. Background

In 1975, the U.S. Energy Research and Development Administration (now a part of the U.S. Department of Energy) initiated a long term research and development program to evaluate the geopressured resources underlying the Gulf Coast region of the United States. Several investigators (see References 1, 2, 3, and 4, Section VII) had recognized the energy potential and suggested that studies be conducted to assess this high risk energy resource.

In March 1979, The Dow Chemical Company (DOW) submitted an unsolicited proposal to drill a well into a small geopressured water reservoir and perform an exhaustive study to evaluate geopressured reservoirs as a source of energy. The specific advantages of this proposed program may be summarized as follows:

1. The reservoir is small and thus data to completely define the production life and production characteristics of a geopressured water reservoir can be obtained in a nine-month production period.
2. The geology of the reservoir is known through well logs and seismic profiles already completed. These data define the size of the sand body and indicate that it is a sealed reservoir in a well-defined fault block.
3. The permeability and porosity of the sand is known to be adequate to support production of up to 25,000 barrels of water per day through the 5½" production tubing.
4. No previous production has occurred in this reservoir, but the same sand has produced gas in other fault blocks.
5. An exploration well was drilled and abandoned on the proposed site in 1974.
6. Extensive geological data has been compiled and evaluated.

In order to conduct these studies, DOE executed a contract with Dow of Midland, Michigan, to conduct the drilling, completion, and testing of one geopressured-geothermal well (i.e., Dow-DOE Sweezy No. 1) and one disposal well in Vermilion Parish, Louisiana. A schedule for the one year testing program is given in Section IV.

B. Program Objectives

The primary objective of this program is to determine the production characteristics of a definable and known geopressured water reservoir. Secondary objectives include observation of the changes in the nature of fluids as production proceeds, evaluation of procedures relative to the mechanisms of producing the fluids, and accumulation of data to evaluate the economics of energy production from the resource.

1. The reservoir production characteristics which the program is designed to determine include:
 - a. Maximum attainable production rate under the conditions of the well and the reservoir.
 - b. Ultimate productivity of the reservoir over its practical production life.
 - c. Reservoir pressure changes as production proceeds and estimation of formation changes which occur.
 - d. Accumulation of baseline data for determination of parameters useful for calculations involving three-dimensional geopressured reservoir modeling.
 - e. Determination of possible contribution of shale water influx on reservoir productivity.
2. Produced fluids will be carefully measured and analyzed to determine:
 - a. Composition of the fluids, both liquid and gaseous.
 - b. Initial gas/water ratio and changes in this ratio as pressure declines.
 - c. Nature of the reservoir fluids prior to production through recombination studies under stimulated reservoir conditions.
 - d. Presence of shale dewatering through salinity changes, trace element occurrence, and reservoir behavior.

C. Location

North Parcperdue field is located in Vermilion and Lafayette Parishes, approximately eight miles south of the City of Lafayette, just off Highway 339. This area of South Louisiana is on a Pleistocene terrace of the Gulf Coastal Plain. Surface elevation is approximately 20 feet and drainage is good. The Sweezy lease is 37.5 acres and is comprised of pasture land. The well location is 1,800 feet from the south line and 1,350 feet from the east line of Section 26, Township 11 south, Range 4 east. Good paved roads access the lease area. Figure VII-1, State of Louisiana map, shows the general location plus the location of El Tigre Lagoon, the site of the No. 1 Edna Delcambre geopressured geothermal test, approximately 30 miles south of Parcperdue. Figure VII-2 shows the location of the North Parcperdue field on the parish highway map and Figure 3 shows the location of the well site. Figures VII-4, VII-5, and VII-6, show the Cibicides jeffersonensis (Cib jebb.) sand and the location of the Dow-DOE Sweezy No. 1 well.

The test well is located in an exceptionally well-defined fault block. Fault cuts in wells, plus extensive seismic data, indicate 19 points of control on the fault boundaries. The high definition of reservoir geometry offers a unique opportunity to study reservoir behavior with a degree of accuracy not available to any other proposed test location. To fully utilize this potential, reservoir testing will be as extensive and thorough as is practically feasible.

D. Geology

1. Regional Geologic Setting

The Gulf Coast geosyncline extends from Alabama to Northern Mexico and covers an area greater than 250,000 square miles. Cenozoic clastic sediments fill the basin and attain a maximum thickness of greater than 50,000 feet in southern and offshore Louisiana, east of the Sabine arch.

Sedimentation patterns are influenced by differential rates of sediment influx changing sea levels, deeply buried salt structures and salt tectonics, and down-to-the coast contemporaneous faulting. Dip is generally southeastward and is modified by a series of younger basinward flexures which exhibit great thickening of sedimentary units on the downdip sides, generally reflecting the effect of contemporaneous faulting.

A major marine transgression occurred during the upper Oligocene epoch. The massive Anahuac shale was deposited at this time on the continental shelf. The proto-Mississippi embayment was located in the area of South-Central Louisiana during Frio-Vicksburg time (upper Oligocene), which further influenced the marine character of the sediments. Minor regressive episodes caused the formation on the Continental Shelf of shoals, barrier bars, and possibly barrier islands. Many of these barrier bars are now targets of oil and gas exploration. They are typically isolated sand bodies in an interval of massive shale and exhibit a coarsening-upward log character. In South Louisiana, such sands are usually identified by a characteristic foram. The objective sand, of the upper Frio formation, is identified by the foraminifera *Cibicides jeffersonensis*, henceforth referred to as Cib jeff.

2. Geology of the Parcperdue Area

The geopressured zone at Parcperdue occurs in sediments of Upper and Middle Oligocene age, principally in the Frio formation. The top of the formation is picked at the first occurrence of the foram *Discorbis gravelli*, which occurs in the abandoned well, the Phillips No. 1-A Sweezy, at a depth of approximately 12,700'. Cross-section B-B¹, Figure VII-7, illustrates the paleontologic sequence in the area.

Production in the field is principally from the Cib jeff and Camerina zones. Camerina is the deepest zone penetrated. The area is traversed by a number of faults which intersect to form discrete blocks. Traps are structural and (gas) production is from closures within fault blocks or against faults. The objective Cib jeff sand is in a fault block bounded by faults "A", "B", and "C" as shown on the structure map, Figure VII-5.

3. Geology of the Cib jeff Sand

The sand occurs at a depth of 13,340 feet and is approximately 80 feet thick. The Cib jeff sand represents an offshore barrier bar environment of deposition. Such deposits are elongated and lenticular in form and may vary in size from a few square miles to several hundred square miles. The Cib jeff sand in the Parcerdue area is conservatively estimated to have an areal extent of about ten square miles. The areal extent of the Cib jeff reservoir within the fault block is approximately 1.5 square miles (See Figure VII-5 and VII-6).

Geologic control on the fault block is excellent. Fault cuts can be picked or inferred in eight wells located near Faults "A", "B", and "C", as shown on the Cib jeff structure map, Figure VII-5. The area is traversed by seven CDP seismic lines which intersect the test fault block at eleven points. The total of nineteen control points affords very accurate mapping of the fault block dimensions, essential in making reservoir calculations. The total area of the fault block has been determined to be 939 acres.

The Cib jeff sand is overlain by approximately 1,300 feet of marine shale and underlain by approximately 3,000 feet of shale. The bounding faults, which range in throw from 150 feet to over 500 feet will provide an excellent seal against the shale and isolate the Cib jeff reservoir. Accepting the hypothesis that shales are the source of geopressure, and that organic shale, under pressure and temperature conditions akin to what exists in the geopressured zone, is the zone of petroleum maturation, then it is expected maximum methane saturation and shale dewatering will occur in this test.

The Cib jeff sand is continuous and relatively consistent in thickness over the test fault block, as illustrated on the isopach map, Figure VII-6.

Assuming an average thickness of 50 feet, reservoir pore volume is $1106 \times 108 \text{ bbl}$ ($939 \text{ ac} \times 43,560 \text{ feet}^2/\text{ac} \times 50' \times 29\% \times 0.178 \text{ bbl/feet}^3$). If the well produces at a rate of 20,000 bpd for a 270 day period, the total water produced

will be 5.4×10^6 bbl. This production represents five percent depletion ($5.4 \times 10^6 / 1.06 \times 10^8 \times 100$) of the reservoir.

The Cib jeff sand reservoir is ideally suited for a test of the geopressed geothermal concept. The reservoir is exceptionally well defined, is consistent within the fault block, is sealed on all sides, and possesses good porosity and permeability. The smallness of the reservoir will afford a significant pressure depletion over a relatively short period of production, thus providing detailed information on the production characteristics of a geopressed reservoir.

4. Test Well Geology

The Dow-DOE No. 1 Sweezy (original hole) was drilled to a T.D. of 13,600' and logged on April 12, 1981. Shallower formations (principally Miocene) are continental-fluvial in nature. Transition to a more marine facies occurs at a depth of approximately 11,800'. Below that depth, the entire section is shale with the exception of three sands, each 100' or less in thickness, occurring at depths of 11,920', and 12,305', and the objective Cib jeff sand at 13,341'.

Palentology was done by George N. May and Associates of Lafayette. A summary of their report is given in Table VII-1. Their complete report is attached as Appendix D.

TABLE VII-1
SUMMARY OF PALEONTOLOGY

SAMPLE RANGE 11500'	-----13,600'
IN SIPHONINA DAVISI	-----11,500'
CRISTELLARIA 47	-----11,900'
NODOSARIA VERTEBRALIS	-----12,170'
SIDCORBIS GRAVELLI	-----12,780'
HET SP. (VERY RARE)	-----12,880'
CIBICIDES JEFFERSONENSIS	-----13,140'
BOLIVINA PERCA	-----13,490'
NO FURTHER DIAGNOSTIC FOSSILS WERE ENCOUNTERED.	

Well logs run in the open hole include Dual induction-SFL sonic, Neutron-Formation density-Gamma ray, Dipmeter, Saraband, Mechanical properties, Temperature log, and Directional survey. The DIL-SFL-Sonic log of the Cib jeff sand interval is shown in Figure VII-4.

Calculated porosity of the massive sand is 30% which is in good agreement with measured values. Salinity calculations from SP are considered unreliable due to variations in the method used. Several calculations were made using the conventional method, the method of Dunlap and Dorfman, and the Rwa method, on both the original hole and the first side-track. Values range from 50,000 ppm to 120,000 ppm, with the best estimate 95,000 to 100,000 ppm.

5. Core Evaluation

Two 60' x 4" conventional cores were taken from a depth of 13,340' to 13,460'. Recovery was 100%. The upper core cut just above the top of the sand and the second core cut approximately 45' of shale below the sand. The sandstone was clean, well sorted, and very viable to unconsolidated. The lower 20' was more consolidated, finer grained, and less porous and permeable. Core evaluation can be subdivided into four parts:

- a. Conventional porosity and permeability measurements performed by Corelab.
Average porosity was 28% and average permeability was 3700 md. Results are presented in Table VII-2.

- b. Lithologic description and mechanical properties performed by Terra Tek, Inc. Terra Tek is also responsible for core preparation, handling, distribution and shipping. The preliminary lithologic description is attached as Appendix E.

Mechanical testing at in-situ conditions will provide data to determine parameters for reservoir testing and reservoir performance prediction and will identify potential problems associated with reservoir production and evaluation. The test matrix is shown in Table VII-3. The complete Terra Tek is attached as Appendix E.

TABLE VII-2

TEST MATRIX

Type	Number	Porosity	Compressibility	Young's Modulus	Poisson's Ratio	Compaction Coefficient	Pore Volume Change	Permeability	Resistivity	Ultra-Sonic Velocity	Strength	Creep Strain
Quick-Response	2	2	2	2	2	2	2	4	--	--	--	--
Compaction	5	5	5	5	5	5	5	10	--	6	--	--
Triaxial	3	3	3	3	3	--	3	6	--	--	3	--
Creep	3	3	3	3	3	3	3	3	--	--	--	3
Resistivity	1	1	--	--	--	--	--	--	1	--	--	--
Total	14	14	13	13	13	10	13	23	1	6	3	3

c. Sieve Analysis, Acid solubility, clay analysis, scanning electron micrography and thin section petrographic evaluation to be performed by Dowell and Dow Chemical. The sieve analysis and acid solubility is attached as Appendix B. Other work to be performed as required.

d. Organic Geochemistry to be performed by Geochem Laboratories. Source rock evaluation of shale sample to include: lithologic description, total organic carbon, vitrinite reflectance, visual kerogen analysis, and bitumen analysis.

TABLE VII-3
PERMEABILITY AND POROSITY ANALYSIS

<u>Sample#</u>	<u>Depth</u>	<u>Permeability Millidarcys</u>	<u>Porosity %</u>	<u>Description</u>
2	13342.5	260	25.9	SD VF-FG SHY
3	13343.2	810	22.2	SD FG SSLTY
4	13344.5	4550	26.4	SD FG CLN
5	13346.5	4370	29.7	SD FG CLN
6	13348.5	4780	29.2	SD FG CLN
7	13350.0	4740	30.1	SD FG CLN
8	13352.7	5160	27.8	SD FG CLN
9	13355.5	7780	29.6	SD FG CLN
10	13357.6	6580	29.3	SD FG CLN
11	13360.5	3650	28.1	SD FG CLN
12	13362.2	2590	27.8	SD FG CLN
13	13364.0	1420	27.8	SD FG CLN SSLTY
14	13365.5	2300	27.4	SD FG CLN
15	13367.5	5350	28.6	SD FG CLN
16	13368.5	27	22.7	SD VGD SSHY SLIG(L) SSLTY
17	13369.5	825	29.4	SD FG SSLTY
18	13370.5	7620	30.5	SD FG CLN
19	13372.5	4920	30.4	SD FG CLN
20	13375.5	2930	29.1	SD FG SSLTY
23	13390.0	205	28.4	SD VFG SLTY
24	13394.5	410	31.5	SD VFG SLTY
27	13397.5	1260	29.2	SD VF-FG SSLTY
28	13400.0	.06	14.8	SD VFG SSHY SLTY
29	13401.0	.36	14.4	SD VFG VSSHY VSLTY
30	13402.0	46	23.3	SD VFG SLTY
32	13405.0	15	21.2	SD VFG VSLTY
33	13406.0	265	25.2	SD VF-FG SSLTY-SLTY
36	13409.0	.26	18.6	SD VFG VSLTY
46	13419.0	0	10.2	SD VFG VSLTY VCALC
61	13438.0	.63	13.1	SD VFG SHY (L) VSLTY
71	13450.0	.35	12.2	SD VFG SS-SHY (L) VSLTY
78	13404.0	1.1	20.9	SD VFG VSLTY

Figure I. State of Louisiana: Location Map

Scale: 1" = Approximately 40 Miles

FIGURE VII-1

Location Map
Louisiana Gulf Coast Area
Showing Well Location

FIGURE VII-4

Cib jeff Sand
I S F LOG

L. R. SWEETZ NO. 1

7-15

FIGURE VII-5

VIII. RESERVOIR TESTING AND EVALUATION

A. RESERVOIR TESTING PLAN

1. INTRODUCTION

The general objectives of the well testing program are to obtain adequate transient pressure test data for evaluating the following:

- a. The deliverability of the geopressured aquifer.
- b. The ultimate producibility of the geopressured reservoir.
- c. Initial gas saturation, gas-water ratio, reservoir gas saturation, critical gas saturation and to observe and interpret changes in the above with pressure depletion.
- d. Accurate values of reservoir parameters for use in numeric reservoir simulation models.

An analytical model incorporating shale water influx, the estimated aquifer properties shown by Table VIII-1 and the approximate aquifer boundary configuration given by the Otis Recommended Well Testing Report of January 11, 1979.

2. SHORT-TERM TEST

The short-term testing includes a sequence of four variable rate isochronal drawdowns and buildups.

The purpose of the short-term test is to determine the reservoir parameters that could vary with flow rate or pressure due to the geopressured effects and evolution of solution gas in the aquifer. To accomplish this task, it is important to keep the flowing pressures at least 30% greater than the normal hydrostatic pressure, i.e., $13,500 \text{ ft} \times .433 \text{ psi/ft} = 5845.5 \text{ psi} \times 1.3 = 7600 \text{ psia}$. Thus, the flow rates should be selected such that the downhole flowing pressures are greater than 7600 psia. This is important due to the compressibility of the rock being discontinuous when the reservoir pore pressure approaches the normal hydrostatic pressure in geopressured systems.

A theoretical short-term test was generated using the aforementioned model and aquifer data. Figure VIII-1 shows the downhole pressure vs. time of the short-term isochronal

test for flow rates of 10000, 15000, 20000, 25000 BBL/D. Notice that the lowest flowing pressure is about 9600 psia which satisfies the aforementioned requirement to keep the pressures greater than 7600 psia. Durations of the first 3 flow and shut-in events are 12 hours each. The last flow and shut-in periods are designed for 96 hours each.

A sequence of short-term pressure drawdown-buildup tests determine the aquifer permeability and thickness as functions of pressure in the presence of pore volume relaxation. Parameters such as initial reservoir pressure, completion efficiency or skin effect, turbulent flow in the reservoir, void space available for wellbore unloading or loading and the volume of water contained within the reservoir area investigated are determined from the short-term analyses. If one or more reservoir impediments such as fault boundaries or sand pinchouts are reflected by the pressure behavior, a more detailed description of the reservoir can be obtained. The additional parameters evaluated in this case include determination of the boundary shape and respective well location, the hydraulic diffusion constant ($k/\phi\mu c$) and the volume of water contained within the reservoir boundaries. If a so-called pseudo steady-state pressure performance is realized during the short-term testing, then calculations of the reservoir storage (ϕch) can be performed as a function of the production rate. These calculations would in turn determine a relationship between reservoir storage and pressure as well as the initial volume of water communicated to the well. Normally, except in testing a small reservoir system, a pseudo steady-state pressure performance is not realized during the initial variable rate testing. It usually requires longer periods of testing for the pressure behavior to reflect total closure of reservoir boundaries.

The information determined from the analysis of the short-term test data will aid in determination of initial feasible rate of production and the study of changes in reservoir parameters with pressure depletion such that the input parameters of a numeric reservoir simulation model will be more reliable.

3. SHORT-TERM TEST PROCEDURE

General considerations for the short-term test are anytime during a flow period that excessive sand starts being produced, the fluid production rates change drastically, or a potential unsafe condition exists, immediately reduce the rate or shut-in the well. Continual monitoring of the

proper disposal of the water is necessary. This will be done using a Hewlett-Packard gauge installed at the disposal wellhead and recording pressure and temperature data on a continuous tape.

One master clock will be used for all measurements and events during the testing program, and as well test data is gathered and analysed alterations of this test procedure will be made.

4. CLEAN-UP FLOW PERIOD*

- a. After the zone of interest has been perforated, open the well to flow into a tank for clean up.
- b. Flow the well until a minimum of 400 BBLS (wellbore volume is approximately 300 BBLS) is produced or until the wellstream has less than 2% extraneous fluids by volume.
- c. Measure and record the following data at the indicated frequency: Wellhead pressure and temperature wellhead flow meter, pressure drop across wellhead flow meter, choke size, volume produced into tank every 15 minutes (automated equipment set on 5 minute mode). Results of samples of wellstream to determine that wellstream is clean every 15 minutes after wellbore is unloaded (= 300 BBLS of production).
- d. After wellbore unloads, keep wellhead pressure greater than 2000 psig.

5. INITIAL SHUT-IN PERIOD

- a. After wellstream is clean, shut-in the well for an initial shut-in.
- b. Measure and record time of shut-in from the master clock.
- c. Measure and record the following data at the indicated frequency.

Wellhead pressure and temperature
every 5 minutes for 1st hour
every 10 minutes for next hour
every 15 minutes for remainder of buildup

Automated equipment set on
5 second mode for 1st 5 minutes
15 second mode for next 10 minutes
1 minute mode for next 45 minutes
2 minute mode for next hour
5 minute mode for remainder of buildup

- d. After well has been shut-in for 1.5 times the clean up flow period, rig up and run the downhole pressure gauges into the hole making stops at surface (lubricator), 5000, 10000, 12000, 13000, 13500 (depth gauge will be set below bottom perforation).
- e. Allow the recorded downhole temperature to become constant before moving to next level of gradient survey. This usually takes 15-30 minutes.
- f. Set gauge below bottom perforation. Record pressures and temperatures for at least 30 minutes before starting another operation. If pressure/temperature is not constant, continue recording until a definite pressure trend is defined.

6. FIRST FLOW PERIOD

- a. Open well to flow at 10000 barrels water/D+ 500 Barrels water/D for 12 hours. Make necessary choke adjustments as soon as possible after opening well. After rate is established, do not change choke size.
- b. Measure and record necessary information to establish the following at the indicated frequency.

Wellhead pressure and temperature, wellhead turbine flow meter, pressure drop across wellhead turbine flow meter, choke size (time of choke changes even if same size), gas flow rate, water flow rate and oil flow rate.

every 15 minutes for 1st 3 hours
every 30 minutes for remainder of flow period

Automated surface equipment should be sent on following modes.

at least

1 minute mode for 1st hour
5 minute mode for next 2 hours
15 minute mode for remainder of flow

Bottom hole pressure/temperature recorder should be on following modes.

1 second mode - 1 minute prior to opening well
10 second mode - until 3 minutes after opening
15 second mode for next 12 minutes
30 second mode for next 30 minutes
1 minute mode for next 45 minutes
5 minute mode for remainder of flow period

- c. Duplicate samples of the oil, gas and water should be taken toward the end of the flow period.
- d. Samples of oil, gas and water should be taken every 4 hours to allow corrected flow rates to be established and to maintain a continual record of the gas, oil and water gravities. If sufficient oil (condensate) is produced, shrinkage factors should be measured and reported.
- e. Calibrate liquid flow meters with a tank every 4 hours during the flow period.
- f. Transmit all corrected well test data to Otis-Dallas every 4 hours during the first flow period. Time of shut-in well be decided after reviewing the data.

7. FIRST BUILDUP PERIOD

- a. Shut-in the well at the wing valve for a 12-hour buildup.
- b. Measure and record the wellhead pressure and temperature; downhole pressure and temperature at the following frequency.
 - 1 second mode for 1st 5 minutes
 - 10 second mode for next 10 minutes
 - 30 second mode for next 45 minutes
 - 1 minute mode for next 3 hours
 - 5 minute mode for remainder of buildup
- c. If leaks are detected during the buildup, reestablish the prior flow rate. Flow the well for 2 times the previous shut-in period before shutting in the well again for a buildup.
- d. Transmit first buildup data to Dallas every 4 hours.
- e. Alteration of test procedures may be needed after analyzing the first flow and/or buildup test data.
- f. Corrosion measurements should be made during build-up period.

8. SECOND FLOW PERIOD

- a. Open well to flow at 15000 Barrels water/D $\pm$ 500 B/D for 12 hours.
- b. Follow the same procedures as outlined for First Flow Period.

9. SECOND BUILDUP PERIOD

- a. Shut-in the well at the wing valve for a 12-hour buildup.
- b. Follow the same procedures as outlined for First Buildup Period.

10. THIRD FLOW PERIOD

- a. Open well to flow at 20000 Barrels water/D $\pm$ 500 B/D for 12 hours.
- b. Follow the same procedures as outlined for First Flow Period.

11. FOURTH FLOW PERIOD

- a. Open well to flow at 25000 Barrels water/D $\pm$ 500 B/D for 96 hours (4 days).
- b. Follow same procedures as outlined in the First Flow Period, except after 12 hours of flow, bottom hole pressure mode can be changed to 15 minutes.

12. FOURTH BUILDUP PERIOD

- a. Shut-in the well at wing valve for a 96-hour (4-day) buildup.
- b. Follow the same procedure as outlined for First Buildup Period, except after 12 hours of buildup, bottom hole pressure mode can be changed to 15 minutes.
- c. After 96 hours of buildup, run a pressure/temperature gradient survey coming out of the hole with the Hewlett Packard instrument. Stops should be made at T.D. 13,500 ft (mid-perforation depth), 13000, 12000, 10000, 5000, 2000, 1000, 500, 200, lubricator.

Note: If gas zone is encountered in wellbore get at least 2 stops in gas zone.

Terminated short-term test and proceed with long-term testing of the well.

13. LONG-TERM TEST

The long-term test will be finally designed after analyzing the short-term test data. Assuming the established reservoir parameters are similar to the parameters given in Table 1, "Estimated Rock and Fluid Properties", the long-term test will consist of several extended flow periods interrupted by periodic short (2-3 days) buildups. The plan is to use periodic surface pressure and temperature; flow rate monitoring plus periodic downhole pressure buildup tests for the long-term testing. This will significantly reduce the testing costs, but will allow sufficient information to be gathered to satisfy the test objectives.

a. Objectives:

The basic objectives are to determine aquifer performance over a relatively long period of flow and to prove aquifer volume within a certain drainage area around the well. In the event that measurable aquifer depletion occurs during the test, the program can be terminated and the total aquifer volume calculated. A material balance procedure for possible delin-eating between shale water influx and a real or peripheral water influx will be used to analyze the long term test data. The material balance procedure can also be used to predict future performance of the aquifer after adequate amount of producing history becomes available.

The aforementioned plans utilize well-established analytic models and techniques for determining an initial description of the aquifer from transient pressure test data. Subsequent refinement of the aquifer description should be performed with the aid of numeric simulation. Initial input for the simulator would include the composite information from all sources. Numeric simulation in 2 or 3 dimensions is recommended for studying the long term effects of rock deformation simultaneous flow of gas and water, aquifer boundaries and shale water influx on the economic viability of this project.

b. General Considerations:

After concluding the short-term, open well to flow on a high rate (possibly 25,000 bbls. water/D) for several days (flow rate and time to be determined after analyzing short-term test data).

The results of two theoretical case studied obtained from the aforementioned analytic model and aquifer data are shown by Figures VIII-2 and VIII-3. Case I, Figure VIII-2, shows the pressure response or shale water influx and line source solutions for the following rate schedules:

First Long-Term Period @25000 B/D
for 22 days
First Long-Term Test Buildup for 2 days
Second Long-Term Test Flow Period
@25000 B/D for 22 days
Second Long-Term Test Buildup for 2 days
Third Long-Term Test Flow Period
@25000 B/D for 22 days

Third Long-Term Test Buildup for 2 days
Fourth Long-Term Test Flow Period @25000 B/D
for 22 days
Fourth Long-Term Buildup for 2 days
Fifth Long-Term Test Flow Period @25000 B/D
for 54 days
Fifth Long-Term Test Buildup for 63 days

The total production of water for this schedule is 3,672,500 barrels or 4.69% of the initial water volume anticipated in the reservoir. The minimum pressure for this schedule and theoretical reservoir is about 7300 psia.

Case II, Figure VIII-3 shows the pressure response for shale water influx and line source solutions for the following rate schedules:

First Long-Term Test Flow Period @25000 B/D for
36 days
First Long-Term Test Buildup for 3 days
Second Long-Term Test Flow Period @25000 B/D for
36 days
Second Long-Term Test Buildup for 3 days
Third Long-Term Test Flow Period @25000 B/D for
36 days
Third Long-Term Test Buildup for 3 days
Fourth Long-Term Test Flow Period @25000 B/D for
52 days
Fourth Long-Term Test Flow Buildup for 14 days

The total production of water for this schedule is 4,122,500 barrels or 5.26% of the water volume initially in-place. The minimum pressure for this schedule is 7172 psia. The drawdown pressures for Cases I and II are well above the normal pressure of 5846 psia @13400 feet depth. It should be noticed for Cases I and II that a good pseudo state pressure drawdown trend is obtained.

14. LONG-TERM TEST PROCEDURES

a. DRAWDOWNS

(1) During long-term test drawdowns measure and record the wellhead pressure (dead weight gauge) and temperature, wellhead turbine flow meter rate, pressure drop across the wellhead turbine flow meter, time of choke changes and choke sizes, gas, water and oil rates every--

- 1 hour for first 3 days
- 2 hours for next 4 days
- 4 hours for remainder of flow period

Note: If rates or pressure vary appreciably during flow, increase frequency of readings.

(2) Transmit well test data to Otis-Dallas on a daily basis.

b. BUILDUPS

(1) Twelve hours prior to buildup, run BHP gauge into hole.

(2) If rate has to be reduced to run gauge, re-establish the prior rate before the rate reduction for 2.5 times the disturbed rate period.

(3) Record at least 6 hours of the drawdown before shutting in the well.

(4) Procedure for gathering the well test data during the buildup will be the same as for the Short-Term First Buildup Period.

(5) Run gradient pressure/temperature survey in wellbore at the end of each long-term buildup as for First Short-Term Buildup.

TABLE VIII-1

ESTIMATED ROCK AND FLUID PROPERTIES
PARC PERDUE PROJECT

Depth, feet	13400
Temperature, °F	235
Initial pressure, psia	12500
Effective permeability to water, md	100
Porosity, % pore space	22
Thickness, feet	50
Water compressibility, psi ⁻¹	2.2×10^{-6}
Water viscosity, cp	0.33
Water formation volume factor, res. bbl/surf. bbl	1.015
Sand compressibility, psi ⁻¹	26×10^{-6}
Shale compressibility, psi ⁻¹	40×10^{-6}
Shale porosity, % pore space	35
Shale permeability, md	1×10^{-4}

B. WELLSITE RESERVOIR ANALYSIS

Programs Available on Site (Otis Nomenclature)

1. Field Data Acquisition
2. Field Data Management
3. Reports Program
4. Graphical Reports Program
5. System Management

1. FIELD DATA ACQUISITION PROGRAM

1. Acquires BHp and BHt from the H.P. Gauge at the operator's selected intervals.
2. Acquires WHp from the H.P. Gauge at the operator's selected intervals.
3. Displays the well status which contains the current, last stored and original - BHp, BHt, WHp and Gradient. It will also display the starting time and the current time as well as the pressure change rate per period of sample, overall pressure change rate and the delta time for that portion of the test.
4. Produces a hard copy printout for the field customer on Otis' form as the test progresses. This printout contains delta time, real time, BHp, WHp, BHt, WHt, choke size and remarks.
5. This program also has continuous graphics which are available on a "call up" basis that is displayed on the CRT. These graphs can be drawn at the same time that the test is running with no delay in the acquisition of the test data. A hard copy is produced for either the customers benefit or is kept in files for later usage. Once these graphs are drawn, they can then be expanded with the upper and lower boundaries being specified by the operator. Delta time can be specified in either minutes or seconds. These graphs are as follows:
 - a. BHp vs. Flow Time
 - b. BHp vs. Log (Flow Time)
 - c. BHp^2 (Mpsia) vs. Flow Time
 - d. BHp^2 (Mpsia) vs. Log (Flow Time)
 - e. Log [PWS-PWF] vs. Log (Shut in Time)
 - f. Pressure vs. Log [(Time + Delta Time) / Delta Time

- g. Pressure vs. Log (Shut in Time)
 - h. Log [PWS² (Mpsia) - PWF² (Mpsia)] vs. Log (Shut in Time)
 - i. Pressure² (Mpsia) vs. Log [(Time + Delta Time) / Delta Time]
 - j. Pressure² (Mpsia) vs. Log (Shut in Time)
6. A selected graph can also be displayed on the 9827B "4 Pen Plotter" as the test progresses in addition to the continuous graphics. The same graphs which we listed above are available. At the end of the portion of the test, any or all of the graphs can be drawn by the plotter.
 7. This program will store all data records including the remarks onto the magnetic tape.
 8. Sequence of events are produced on the 515A as a hardback copy for future use.
 1. WHp and BHT can be added to the Graphical representation of data providing a more comprehensive view of the well's performance during the test.
 2. Disk Packs will be used to increase our storage capacity and to decrease data retrieval time.
 3. There will be provisions made for the addition of Data Acquisition of the production testing equipment. This data, along with the well data, will be assimilated using the same time base mechanism.

2. FIELD DATA MANAGEMENT PROGRAM

1. Creates header file.
2. Provides entry of well data into the header file.
3. Provides capabilities of editing the data in the header file.
4. Creates the portion file.
5. Provides entry of test data into the portion file.
6. Provides capabilities of editing the data in the portion file.
7. Lists data from field data tape for review.
8. Provides capabilities of editing the data from the field data tape or from the permanent data file.
9. Creates the permanent field data file.
10. Transfers the field data.

3. REPORTS PROGRAM

This program simply produces any number of copies of the field desired.

4. GRAPHICAL REPORTS PROGRAM

This program is broken down into two groups.

1. The extended graph produced by the 9845 of the entire test being labeled on the graph as well as any events that effected this test.
2. The graphs produced by the 9872B are of individual portions of the test, with comments added to explain occurrences which affected the pressure transients.

NOTE* - These graphs may be produced in any quantity desired and may be produced using one of the three.

- a. BHp
- b. WHp
- c. BHt

5. SYSTEM MANAGEMENT

1. This program recreates the field program tapes.
2. Creates new field data tapes.

C. ROCK MECHANICS

1. QUICK RESPONSE LABORATORY TESTING

To assist in the evaluation of short-term reservoir testing, Terra Tek will perform two tests on sandstone immediately upon receipt of core samples in Salt Lake City. These tests will consist of sample characterizations (density, porosity, description), preparation for high pressure, high temperature testing (machining, jacketing and saturating), and then the following:

The test sample will be brought to full simulated reservoir conditions (total overburden stress $\approx 14,000$ psi, confining pressure agreed upon with Dow, pore pressure $\approx 12,000$ psi, and temperature $\approx 240^\circ\text{F.}$). Pore fluid will be brine (90,000 mg/l NaCl).

During this phase of testing, a compressibility will be determined. Then, at reservoir conditions, permeability will be determined by the steady-state technique. From initial reservoir conditions, pore pressure will be reduced by 3,000 psi (to $\approx 9,000$ psi) while varying confining pressure to maintain a uniaxial strain condition. In this way, a uniaxial compaction coefficient will be determined. Permeability will again be measured. Finally, initial conditions will be restored to determine hysteresis. During the entire test, all pressure, strain, and temperature and pore fluid volume variations will be monitored and recorded by a computer data acquisition system. A description of the testing system is found in the next section of this proposal. It is expected that the quick-response testing will be completed within 3-5 days of receipt of core. Results will be immediately transmitted to DOW by telephone and letter.

2. GENERAL LABORATORY TESTING

Following the quick-response testing, setup, sample preparation, and characterization will proceed for the remainder of the tests to be done. Several possible test machines are available for the work. The basic machine capabilities equal or exceed 15,000 psi confining pressure, 25,000 psi total axial stress (on whole core, correspondingly more on smaller samples), 15,000 psi pore pressure (brine), 300°F temperature. Sample size capability (cylindrical samples) is up to whole core (4-inch diameter by 8-inch length). For this program, 2-inch diameter by 4-inch long samples, will be used in order to insure good resolution but still be certain of a sufficient quantity of core for testing.

Sample preparation will be the same as for quick response testing. Four basic types of tests will be run. The philosophy of test planning has been to obtain as much data as possible in each test procedure so that the minimum number of tests will be run.

- a. Compaction Tests. Procedure will be as described in short-response testing. That is, increase pressures and temperature to reservoir conditions with compressibility determination, reduce pore pressure for uniaxial compaction determination and then increase pore pressure for hysteresis determination. Permeabilities at initial and reduced pore pressure will be measured. If necessary, shale permeability will be determined by the pulse method. Five tests will be run. Four are planned for sand and one for shale. (Added to the two earlier

tests, this makes a total of ten tests in this category). For all tests, axial and lateral strain and pore fluid volumes will be measured. For a limited number of these tests (planned three) ultrasonic velocities will also be measured at reservoir conditions.

- b. Triaxial Tests. Procedure will be to attain reservoir conditions, measuring compressibility, and then permeability as before. Three sand samples will be tested. Pore pressure will then be reduced to a different level on each specimen to produce three different effective stress levels. Then, axial load will be increased to failure while strain and pore fluid volume are measured. In this way, a failure envelope will be approximated. The pre-failure strain measurements will also give measurements of Young's modulus and Poisson's ratio.
- c. Creep Tests. Procedure will be to attain reservoir conditions as before, measure permeability, and then reduce pore pressure to 7,000 psi while maintaining uniaxial conditions. Then, conditions will be held constant and creep strain observed for a minimum of one week and a maximum of three weeks. This will be done on three samples (two sands and one shale). Results will allow the importance of creep compaction to be determined.
- d. Resistivity. Procedure will be to attain reservoir conditions as before, and then measure electrical resistivity on one sand sample to provide a log correlation.

A summary of the tests to be run and measurements achieved is shown in Table VII-2. A minimum of 10 compressibilities, 10 uniaxial compactions, 12 permeabilities, 3 triaxials, and 3 creep tests will be run. Fourteen test setups are planned, but by careful combination of simultaneous and sequential tasks, a total of more than 100 separate tested parameter values are obtained.

In addition to the high-temperature, high-pressure testing, all samples will be studied petrographically, both before and after testing. Post-test work will attempt to correlate effects observed in the mechanical testing with physical or chemical changes observed in the core.

D. P-V-T ANALYSIS

Initially, fluid samples will be taken at four to eight hour intervals. During long term testing, samples will be taken at intervals determined by the rate of change in fluid composition. Down-hole sampling is believed to be unreliable with presently available sampling equipment, hence no provision has been made for down-hole sampling.

The purpose of the PVT work is to supply data on the physical characteristics of the fluids at reservoir temperature and pressure. Good PVT data will be essential in making an accurate interpretation of reservoir behavior and this information will be used in conjunction with the pressure data obtained by Otis for reservoir modeling and prediction. Eight basic types of tests will be run.

1. WATER VAPOR CONTENT OF SEPARATOR GAS
To aid in determination of true GWR.
2. DRY NATURAL GAS ANALYSIS BY STANDARD GC
Mole % CO₂, N₂, C₁, C₂, C₃, iso C₃, iso C₄, n-C₅, n-C₅, C₆, C₆⁺.
3. FLASH LIBERATION OF GAS FROM SEPARATOR WATER
Solution GWR, stock tank water gravity, vol. stock tank water/vol. separator water.
4. PHYSICAL RECOMBINATION OF SEPARATOR EFFLUENTS
At least 4 will be done per sample at various pressures to develop a saturation pressure vs. GWR curve.
5. DIFFERENTIAL LIBERATION OF RESERVOIR FLUID AT RESERVOIR TEMPERATURE
Formation volume factors (B_w, B_g), differential liquid volume changes, solution gas water ratios.
6. PRESSURE-VOLUME RELATIONS OF RECOMBINED RESERVOIR FLUID AT RESERVOIR TEMP
Bubble point, relative volumes, specific volumes, density, liquid volume percent, saturation pressure vs. recombined GWR.
7. SPECIFIC GRAVITY AND COMPRESSIBILITY OF DIFFERENTIALLY LIBERATED GAS
Incremental and accumulated specific gravities, gas compressibilities, gas volume factors.
8. VISCOSITY OF RESERVOIR FLUID AT RESERVOIR TEMP
Viscosity in centipoise from atmospheric pressure to 10,000 psi extrapolated to reservoir pressure. A modification of the standard method for determining oil viscosities will be used, measuring change in resistance across contacts of rolling-ball viscometer.

E. CHEMICAL ANALYSES OF BRINE AND GAS

1. GENERAL

The principle analyses of the fluids, both liquids and gases, will be performed on the site. A 12' x 56' laboratory trailer has been set up for this purpose. The laboratory contains, along with ordinary wet chemical analysis equipment, a model 3700 Varian gas chromatograph, a model AA-475 ABD double beam atomic absorption/flame emission spectrophotometer, a conductivity bridge complete with cell, a kirsematic bath for density and viscosity measurements, a pH meter and a Bausch & Lomb Spectronic 21 spectrometer.

The laboratory will be manned by personnel from the University of Southwestern Louisiana under Dr. John R. Meriwether. Special analyses will be performed at the USL campus and samples analyzed at the site will be checked periodically at the USL campus and at the Dow analytical laboratories in Freeport, Texas. The primary effort on the USL campus will be the analysis of the brines for trace quantities of metals such as vanadium. It is believed that the variations in the levels of trace metals as production proceeds will be an important clue to the presence or absence of influx water from the shales surrounding the sand. The laboratories at USL are equipped, and have developed the techniques, to perform these trace metal analyses using the particle induced X-ray emission (PIXE) method.

2. SAMPLING

a. Frequency

First day of any test - Two (2) in duplicate

Further days of short term tests - daily in duplicate

Further days of long term tests - daily until trends have been established then as needed but not less than one (1) bi-weekly.

b. Techniques

In general, samples will be taken following the methods and procedures given in "Standard Sampling and Analytical Methods for Geopressured Fluids", McNeese State University, 1980, B.E. Hankin, Editor. However, it is planned to perform some investigation of other sampling techniques as time permits. Guide for this work will be the work of the Pacific Northwest Laboratories, operated by Battelle Memorial Institute, on field and laboratory analysis of geothermal fluid.

Because of the difficulty of obtaining valid samples of two-phase fluids, as can be expected in geopresses wells, it is anticipated that separator output flows will be the most frequently sampled fluids.

3. ANALYSES AND DETERMINATIONS

1. BRINE SAMPLES

The following determinations will be made on each brine sample collected: pH₁T, specific conductance, total dissolves solids, suspended solids, Na, K, Mg, Ca, Ga, Sr₁ total alkalinity, CO₂ alkalinity, Cl, F, S, SO₄, SiO₂, Cd, Zn and NH₃.

Periodically samples will be analyzed for other elements such as Hg, As, Cu, Pb, Mn, B, Ra, gross radioactivity and trace metals.

2. GAS SAMPLES

All gas samples will be analyzed for C₁ - C₅ hydrocarbons, C₆+ hydrocarbons, CO₂, N₂, NH₃, H₂, O₂, Rn and water. Selected samples will be further analyzed and checked for other components by mass spectrometry in the Dow Laboratories.

3. MISCELLANEOUS ANALYSES

Other materials such as suspended solids, scales, corrosion productd, etc. will be analyzed by the appropriate methods in the Dow Laboratories.

F. DESCRIPTION OF SURFACE FACILITIES

A plan of the Parcpardue site is given in Figure VIII-4 and a schematic of the surface equipment and hookup is given in the production testing well site flow diagram, Figure VIII-5.

1. TEST WELLHEAD

A schematic diagram of the test wellhead and casing spools is shown in Figure VIII-6. The test wellhead is rated for 10,000 psi; however, the maximum expected surface pressure is 5,000.

2. FLOW CONTROL SYSTEM

The brine flows from the test wellhead through two banks of manually-operated adjustable choke valves in series. The choke valves are used to set the brine flow at or near the desired rate; the flow rate then varies with variations in

the upstream pressure unless the choke valve settings are readjusted manually.

3. BEST CHOKE VALVES

The Best Choke Valve Manifold is rated at 10,000 psi. Brine flow from the test wellhead enters the choke manifold, and then is directed through one or both adjustable choke valves arranged in parallel before reaching the manifold outlet. (The choke valves are sized such that the entire design flow rate of 20,000 B/D can be passed through each valve). Thus, the brine flow will normally be directed through only one of the parallel choke valve legs and the other will be a spare. This arrangement precludes the necessity of shutting-in the test well to repair or replace one of these choke valves.

4. BRINE/GAS SEPARATOR SYSTEM

As the well is opened and brought to production, adequate time will be needed to clean up and stabilize the pressure. During this time period the well stream will flow thru the choke manifold, taking the pressure drop down stream of the manifold, then flow thru the by-pass systems on the production separator and on to the disposal pit. After adequate clean up time is allowed the well is flowed directly into the Brine Gas Separator System for gas separation and recovery.

As the pressure is decreased across the choke valves from the expected wellhead pressure of about 5,000 psi to about 1,000 psi, natural gas as well as other gases (e.g., carbon dioxide) will be released from solution in the brine. The two-phase gas liquid flow is then directed into the brine-gas separator system for the gas separation and recovery sequence in the process.

The brine/gas separator vessel (V-301) is a horizontal cylindrical vessel with an OD of 48 inches and a length of 12'6" headseam. The separator system was designed for a 20,890 B/D brine flow rate containing 5.0 MSCF/D of gas. This will give adequate capacity for normal operation. For more the 20,000 B/D production rate, a second separator will be installed as needed in parallel. The two separator system is shown in Figure VIII-5. The design operating pressure and temperature were 1,000 psig and 300°F, respectively. The maximum working pressure is 1,440 psig at 105°F, which is reduced to 1,290 psig at 350°F. The linear velocity across the separator will be 0.32 feet/sec. at the design flow rate of 20,000 B/D and thus residence time in the separator will be about 100 seconds. The gas and water vapor thus separated

from the brine flows upward and out the top of the separator. Pressure control on the separator system is maintained through a split-range pressure indicator/controller, which adjusts the gas flow primarily to a gas pipeline system and secondarily as required to the flare system. However, during the testing phases all gas produced will be sent to the flare.

The brine level in the separator is controlled by a liquid level indicator/controller, which sets the rate of brine flow out the bottom of the separator. Although no oil is expected, the separator has also been equipped with a 2-foot vertical baffle plate, so that oil/brine separations could be made in the vessel with only minor external additions should minor quantities of oil be produced.

5. PRODUCTION GAS SYSTEM

The gas and water vapor from the separator is sent via split-range pressure control on the separator to the field flare. Provision is made to divert gas flow to a compression facility and into a gas pipeline which is adjacent to the Sweezy property. A decision to flow gas to the pipeline will be made when the quality and quantity of gas production has been established.

6. INHIBITOR INJECTION SYSTEM

We have provisions to accomodate Inhibitor Injection System if the need arises. Injection ports have been provided in the header, just down-stream of the pneumatic safety valve.

7. SURFACE TANKAGE

One, one hundred barrel pressurized tank will be used during the initial production test for separator liquid meter proving. This vessel can also be used during clean up if desired. Fluid produced will be dumped into the disposal pit as needed. Primary usage will be meter calibration.

8. PRESSURE RELIEF SYSTEMS

There are basically two types of pressure relief systems in the surface facilities design: firstly, there are conventional pressure relief or pop valve systems which relieve at preset pressure settings, and secondly, various pressure sensors which relieve the abnormal pressure situation by actuating the Emergency Shutdown System (ESD) which closes gate valves and on the test wellhead, and thus shuts-in the well. Pressure sensors, which actuate the ESD system and shut-in

the test well, have their locations and respective pressure settings as follows:

- a. Test Well Christmas Tree
High Pressure 0-7000
Low Pressure 0-2500
- b. Test Production Separator (2)
High Pressure 0-1300 psi
Low Pressure 0-400 psi

These pressure relief systems are designed to adequately protect the integrity of the surface facilities, and thus facilitate safe testing operations.

9. FLOW MEASUREMENT

Liquid measurement will be made by Mock P/D meters and Rotron turbine meters. The Rotron meter is located upstream of the choke manifold measuring the total fluids produced, and the mock P/D meters are located on the separator liquid dumps measuring produced liquids. Gas flow rate is measured by instruments gauging pressure drop across an orifice plate.

Total flow will be measured using a Halliburton turbine meter placed just upstream of the Best choke valve manifold. Sensors will be placed upstream and downstream of the turbine meter to measure pressure drop across the meter.

10. DATA ACQUISITION SYSTEM

An automatic system will monitor and record pressure, temperature and flow data and will determine well head and separator pressure and temperature, gas and water flow rates, GWR, corrected volumes and cumulative production.

The system will record a minimum of 16 channels on tape or disc and will include the following sensors:

- a. Well head pressure 0-10,000 psi
- b. Well head temperature -10-100° c
- c. Separator temperature (2) -10-100° c
- d. H₂O rate (2) Rotron 3" meter
- e. H₂O rate (2) Flowco 2" meter
- f. Orifice meter temperature -10°-100° c
- g. Orifice meter differential pressure 400" H₂O

- h. Orifice meter static pressure 0 - 1500 psi
- i. Differential pressure across Halliburton Turben Meter 0 - 800 psi

The system will have the capability to record data on tape (or disc) and to generate hard copy of any information. CRT display will be available. Software will include the ability to correct various data to standard conditions. The ability to generate various plots by computer, such as the Hoerner plot, is available.

Sampling intervals for recording various data will be adjustable, ranging from a minimum of 5 sec. upward.

11. SAND DETECTORS

Sand production rate will be monitored with 1-JMS Systems sand detectors. One sand detector will monitor the actual sand production rate from the test well. The sand detector system consists basically of (1) a preamplified acoustical probe in the brine flow line and probe cables, (2) panel-mounted signal processing electronics, and (3) panel-mounted strop-chart recorders for data display and sand production quantification. When a probe is struck by a particle of sand in the brine stream, an acoustically-sensitive crystal in the probe converes the acoustical "pinging" of the impinging sand into a electronic signal, which is processed by the electronic circuitry and then the signal output is displayed on a strip-chart recorder.

12. SAFETY SYSTEM FOR EMERGENCY SHUT-DOWN

The system consists, basically, of pressure sensors, liquid level controllers and manual ESD panels which will actuate the pneumatic gate valves on the test well head and a flow line master gate valve. The gate valves are pneumatically operated so a constant air supply of 80 psi is needed to maintain the valve in an open position. All pilots or ESD panels are of the block and bleed design; therefore, if air supply is stopped the valve will actuate and close. All safety pilots will be present in a safe operating range. If an extreme condition should arise, the pilot will react and actuate the pneumatic gate valve.

The overall pilot system consist of three parts:

- a. Pressure sensitive pilot, located on the well head, and pressure vessel.
- b. Liquid level controllers, located on the pressure vessel.
- c. ESD panels located at critical areas around the production test facilities.

THEORETICAL SHORT-TERM TEST STUDY
ROE-BOW PARC PERDUE PROJECT

First Flow = 10000 R/D for 12 hours
Second Flow = 15000 R/D for 12 hours
Third Flow = 20000 R/D for 12 hours
Fourth Flow = 25000 R/D for 96 hours

First Buildup = 12 hours
Second Buildup = 12 hours
Third Buildup = 12 hours
Fourth Buildup = 96 hours

• - Pressure (Shale Water Influx) (psia)
o - Pressure (Line Sources) (psia)

FIGURE VIII-1

THEORETICAL CASE 1, LONG-TERM TEST FOLLOWING SHORT-TERM TEST
DOE-DOW PARC PERDUE PROJECT

First - Fourth Long-Term Flow @ 25000 B/D for 22 days
Fifth Long-Term Flow @ 25000 for 54 days

First - Fourth Long-Term Buildup for 2 days
Fifth Long-Term Buildup for 6.3 days

Total Production = 3,672,500 Barrels of water during Test or 4.69 % of total water

- - shale water influx solution
- - line source solution

FIGURE VIII-2

THEORETICAL CASE 2. LONG-TERM TEST FOLLOWING SHORT-TERM TEST
DOE-BQW PARC PERDUE PROJECT

First - Third Long-Term Flow @ 25000 B/D for 36 days
Fourth Long-Term Flow @ 25000 B/D for 52 days

First - Third Long-Term Buildup for 3 days
Fourth Long-Term Buildup for 14 days

Total Production = 4,122,500 Barrels of water during Test or 5.26 % of total water

• - shale water influx solution
• - line source solution

FIGURE VIII-3

8-27

Figure VIII-4
8-28

EQUIPMENT LIST			
1.	1" TOL. W/4" NPT NEEDLE VALVE		
2.	3/16" 10,000 PSI SAFETY VALVE		
3.	1" TOL. W/4" NPT NEEDLE VALVE		
4.	1" TOL. W/4" NPT NEEDLE VALVE		
5.	1" TOL. W/4" NPT NEEDLE VALVE		
6.	1" TOL. W/4" NPT NEEDLE VALVE		
7.	1" TOL. W/4" NPT NEEDLE VALVE		
8.	1" TOL. W/4" NPT NEEDLE VALVE		
9.	1" TOL. W/4" NPT NEEDLE VALVE		
10.	1" TOL. W/4" NPT NEEDLE VALVE		
11.	1" TOL. W/4" NPT NEEDLE VALVE		
12.	1" TOL. W/4" NPT NEEDLE VALVE		
13.	1" TOL. W/4" NPT NEEDLE VALVE		
14.	1" TOL. W/4" NPT NEEDLE VALVE		
15.	1" TOL. W/4" NPT NEEDLE VALVE		
16.	1" TOL. W/4" NPT NEEDLE VALVE		
17.	1" TOL. W/4" NPT NEEDLE VALVE		
18.	1" TOL. W/4" NPT NEEDLE VALVE		
19.	1" TOL. W/4" NPT NEEDLE VALVE		
20.	1" TOL. W/4" NPT NEEDLE VALVE		
21.	1" TOL. W/4" NPT NEEDLE VALVE		
22.	1" TOL. W/4" NPT NEEDLE VALVE		
23.	1" TOL. W/4" NPT NEEDLE VALVE		
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100.	1" TOL. W/4" NPT NEEDLE VALVE

FIGURE VIII-5

DRAWING REVISION RECORD										DRAWING REVISION RECORD										REVISION										<div> THE DOW CHEMICAL COMPANY</div> <div>DOE CHEMICAL-DOE No.1 L.R. SVEEZY</div> <div>PRODUCTION TESTING WELL SITE FLOW DIAGRAM</div> <div>JOB NUMBER: SCALE: B</div>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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GAS CLEAN UP AND COMPRESSOR

FIGURE VIII-5 CONT'D

5-1/2", 10,000 Flanged Tree top
w/needle valve & 10,000 psi gauge

5-1/2", 10,000 stainless steel
trimmed gate valve (manual).

5-1/8", 10,000 Special "Y" Tee.

6" SCH. SSS long radius
90° turn.

5-1/8", 10,000 Stainless
Steel Gate Valve (manual).

5-1/8", 10,000 Stainless Steel
Gate Valve (w.operator)

5-1/8", 10,000 Stainless Steel
Gate Valve (manual)

9", 10,000 x 5-1/8", 10,000 spool

9" x 5-1/2" FBB tubing Hanger

11", 10,000 x 9", 10,000
Tubing Spool w/2-2" flanged
outlets

11" x 8-5/8" slip-type
hanger

16", 5000 x 11" 10,000 Casing
Spool w/2-2" Flanged Outlets

16", 5000 SO Casing Head

16" Surface Casing

10-3/4" Intermediate Casing

8-5/8" Production Casing

5-1/2" Production Tubing

1 13/16" 10,000 tapped flange w/
tapped bull plug, needle valve &
gauge

1 13/16" 10,000 psi Flanged Gate Valve

1 13/16" 10,000 Tapped Flange w/Tapped bull
plug, needle valve & gauge

1 13/16", 10,000 Flanged Gate Valve

16" x 10-3/4" Slip Type Hanger

2", 5000 Gate Valve

WELLHEAD AND X-MAS TREE
Figure VIII-6
8-30

IX. REPORTING

All reports (except daily and monthly) will be submitted to DOE/NV by the Contractor for review prior to publication in accordance with the Uniform Contractor Reporting System (UCRS) guidelines. The UCRS guidelines include format, number of copies, and submittal schedules. In summary, the reports will consist of the following:

A. Management Plan

The contractor's plan to manage the effort described in the statement of work. It will contain management methodologies, control systems, and procedures it will use to perform the effort identified in the Contract. It will include milestones and other planning schedules, organizational identifications and descriptions, and special and critical plans, such as test plans and plans for the handling of Government-owned property. Work breakdown structures, key personnel identification, and methods for monitoring progress toward objectives will be required.

B. Milestone Plan and Management Report

The Contractor's milestone schedule for all work breakdown structure items, line items, or deliverables specified in the Contract. To be updated periodically (usually monthly) to show status, progress toward total contract completion, and percent completion of each line item.

C. Contract Management Summary Report

A single-page graphic presentation of integrated cost, major milestones, and manpower for rapid visual analysis and trend forecasting.

D. Major Milestone Status Plot

A periodic graphic presentation of events, deliverables, or major milestones and associated dates plotted in an expected performance envelope for rapid visual analysis and trend forecasting.

E. Cost Management Report

A periodic report of the status of costs compared to the Cost Plan. Data will be used to report actual and project accrued costs, evaluate performance against plan, identify actual and potential problem areas, construct cost experience for projects and budgeting efforts, and to verify the reasonableness of Contractor's invoices.

F. Technical Progress Report

1. Daily Test Report

An informal activity report submitted daily throughout the testing phase. The daily report will be phoned or telecopied directly to the Nevada Operations Office and the Geopressure Projects Office. The report will follow the format of the forms shown in Figure IX-1 and IX-2.

2. Technical Progress Report

A monthly technical report describing accomplishments made during the month, the present status, and the planned work schedule for the succeeding month. The total cumulative cost (invoices paid by Dow) through the end of the month should also be included. Problems that have occurred will be discussed along with the method of solution. Test measurement results and analytical data will be presented.

The monthly "Technical Progress Report" must be received by the Nevada Operations Office by no later than the fifteenth day after the end of each month.

G. Analytical Reports

All analytical results will be recorded and reported to the Nevada and Houston Offices of the Department of Energy by telecopy. The format of these reports will follow the forms shown in Figures IX-3, IX-4 and IX-5.

H. Final Reports

These written reports will correlate findings of flow tests and analyses and will include a summarization of the operational aspects of well activities. The reports will also include the evaluation of the completion technique and production strategy; the result of sand stability investigations, including the maximum and reasonable rates at which the well and the reservoir will safely operate; the determinations concerning corrosion and scaling properties of the produced fluid and any treating methods that can be used to control corrosion or scaling problems; evaluation of the reservoir deliverability and depletion, including appropriate material-energy balance equations of use; determination of reservoir size as indicated from test data; reservoir fluid characteristics, including salinity, formation compaction related to any detected surface subsidence, and discussion of the heterogeneity of the reservoir if detected.

1. Yearly Technical Report

A technical report will be submitted in draft form upon completion of each contract year. It will describe operational procedures followed, drilling completion and testing methods employed, and it will provide measurement and test information with all necessary illustrations, graphs, and tabulations required to show significant results. Descriptive text will be used to explain all illustrations.

2. Final Technical Report

A report will be submitted at the conclusion of the program presenting a summary of overall program results. It will be a complete report on all significant data obtained and will be a composite of work performed by all investigators directly related to the drilling and testing of the production well, drilling and utilization of the disposal well(s), and operation of the surface facility.

VERMILION PARISH, LA.

DAILY TEST REPORT

DAY ENDING 6 AM

19

[illegible]

FIGURE IX-1

DAILY ACTIVITY LOG REPORT

DAY ENDING 6 A.M.

19

[illegible]

FIGURE IX-2

DOW CHEMICAL/DEPARTMENT OF ENERGY
L.R. SWEET NO. 1 WELL
VERMILION PARISH, LA
ON-SITE LABORATORY REPORT

DAY ENDING 6 AM _____, 19____

BRINE

SAMPLE TEMPERATURE _____

PH _____

SPECIFIC CONDUCTANCE _____

DISSOLVED SOLIDS _____

SUSPENDED SOLIDS _____

ALKALINITY

CL _____

S _____

REPORTED BY: _____ DATE: _____

GAS (DRY)	MOL %	GAL/min	PPM
N ₂	_____	_____	
H ₂ S	_____	_____	_____
CO ₂	_____	_____	
C ₁	_____	_____	
C ₂	_____	_____	
C ₃	_____	_____	
I-C ₄	_____	_____	
N-C ₄	_____	_____	
I-C ₅	_____	_____	
N-C ₅	_____	_____	
C ₆ +	_____	_____	

REPORTED BY: _____ DATE: _____

DOW CHEMICAL/DEPT. OF ENERGY
L.R. SWEETZ NO. 1 WELL
VERMILION PARISH, LA.
BRINE ANALYSIS REPORT

SAMPLE TAKEN: Time _____ Date _____ By _____

SAMPLE ANALYZED: Time _____ Date _____ By _____

SAMPLE REPORT SUBMITTED: Date _____ By _____

DESCRIPTION:

pH
Alkalinity
Dissolved Solids
Suspended Solids
Conductivity
Specific Gravity
Total Hardness
Sodium
Potassium
Calcium
Magnesium
Barium
Iron
Strontium
Chloride
Bicarbonate
Carbonate
Hydroxide
Sulfate

Arsenic
Boron
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Zinc

Ammonia
Sulfide
Silica, Dissolved
Fluoride

DOW CHEMICAL/DEPT. OF ENERGY
L.R. SWEETZ NO. 1 WELL
VERMILION PARISH, LA.

GAS ANALYSIS REPORT

SAMPLE TAKEN: Time _____ Date _____ By _____
SAMPLE ANALYSIS: Time _____ Date _____ By _____
SAMPLE SUBMITTED: Date _____ By _____

GAS ANALYSIS

(Dry)	Mol %	GPM
Rn-222		
H ₂		
N ₂		
CO ₂		
H ₂ S		
Mercaptans		
SO ₂		
NH ₃		
He		
C ₁		
C ₂		
C ₃		
i-C ₄		
n-C ₄		
i-C ₅		
n-C ₅		
C ₆		
C ₇ +		
Mol. Wt.		
Sp. Gr.		
HHV Wet		
HHV Dry		
STP 14.65 PSIA and 60°F		

FIGURE IX-5

X. OCCUPATIONAL HEALTH AND SAFETY

A. General

All drilling operations and other site activities will be conducted in accordance with standards set by the Occupational Safety and Health Act of 1970 (OSHA).

All participating organizations are responsible for the health and safety of their own personnel and for conducting all activities in accordance with procedures that assure:

1. A safe and healthful environment for the employees.
2. Control and minimization of hazards to the public and to personnel of other participants.
3. Minimization of accidental damage or loss of equipment, materials, and property.

No unauthorized personnel will be permitted on location. Dow Oil and Gas Division safety rules will apply, a copy of which will be available at the well site.

B. Site Access

Because of the hazardous nature of geopressured-geothermal well testing operations, Dow will control access to the test site and will arrange all visits of nonproject personnel.

C. Fire Protection

1. Hand-operated fire extinguishers for the drill rig and other surface equipment will be provided. Extinguishers will be available for control of Class A, B, and C fires.
2. "No Smoking" signs will be placed 100 feet from the production facilities.
3. A wind sock will be installed which is visible from all points on the site.

D. Industrial Hygiene

Potable water and chemical or standard toilets will be provided at all areas where personnel are stationed on a full-time basis. The chemical toilets will be serviced on a regular basis. Solid wastes will be disposed of in accordance with local regulations.

E. Safety Hazards

1. Hydrogen Sulfide

None expected. Normal precautions will be taken by placing H_2S detectors in the area and monitoring same.

XI. ENVIRONMENTAL MONITORING PLAN

A. Introduction

Louisiana State University (LSU) will undertake management of environmental baseline and monitoring studies for geopressured test well activities in the North Parcperdue Oil and Gas Field near Lafayette, Louisiana. The Dow Chemical Company, in cooperation with the U. S. Department of Energy (DOE) is currently planning to drill and test a well penetrating a limited geopressured reservoir in the Parcperdue field at the location given in Section I. A schedule for the two-year drilling and testing program, which was initiated in October, 1979, is given in Section VI.

The drilling and testing operations associated with the Parcperdue geopressured well will be conducted within the scope of an Environmental Impact Assessment (EIA) which is currently being prepared by the Oak Ridge National Laboratory. In this EIA, the environmental implication of geopressured resource testing at Parcperdue is evaluated for activities from well site preparation through site restoration after testing is complete.

B. Environmental Baseline and Monitoring Studies

The purpose of collecting environmental baseline data is to provide a description of selected physical, chemical, and biological conditions against which later environmental monitoring data can be compared. This comparison will provide a basis for determining the net environmental change attributable to test well operations at any subsequent time.

The following data shall be collected to establish the baseline of ambient conditions prior to fluid production:

Air Quality

- .existing air quality conditions
- .local meteorological characteristics

Water Quality (surface and subsurface)

- .existing water quality conditions
- .water resource usage
- .hydrologic patterns, surface and ground water levels

Subsidence

- .subsidence history
- .leveling surveys

Seismicity

- .microseismic surveys

Ecosystem Quality

- .biological surveys

In order to avoid duplication, information presented in the DOE/Oak Ridge Environmental Impact Assessment for the parcperdue well test shall be incorporated where possible in the LSU environmental baseline evaluation. For example, very little additional work may be required to establish existing ecosystem quality.

An environmental monitoring program designed to provide comparative data during drilling and production phases will include the studies listed below. The asterisk indicates the studies that are contingent upon the occurrence of environmental changes (e.g., changes in air quality and/or standards violation in the case of air quality) and are not considered in the base scope of work.

Air Quality

- .air quality monitoring
- .pollutant dispersion modeling*
- .continuous wind speed, wind direction, temperature and precipitation

Water Quality (surface and subsurface)

- .water quality monitoring
- .water level monitoring

Subsidence

- .repeated leveling surveys

Seismicity

- .continuous microseismic surveys

Ecosystem Quality

- .biological surveys*
- .bioassays*

Monitoring studies may be increased if environmental conditions, either natural or as a result of test well activities and geopressure fluid analysis, require such adjustment. However, LSU will be obligated to demonstrate the inadequacy of the existing data collection program when seeking approval for additional studies.

The combined scope of environmental baseline and monitoring studies which are planned during the first year include the air quality, water quality, subsidence, seismic and ecological studies described below.

1. Air Quality

Air quality baseline studies will be performed to:

- (1) determine ambient air quality prior to possible disturbance from test well activities;
- (2) identify any substance potentially derived from the geopressured fluid that may have an adverse effect on the environment, and establish baseline concentrations for these substances;
- (3) collect locally available meteorological data necessary for understanding dispersion and convection patterns; and
- (4) provide baseline data compatible with later measurements needed to assure compliance with state and federal air quality standards.

Air quality monitoring will be performed to determine changes in air quality which may be related to well testing activities. Sampling and analysis for hazardous substances will be from a fixed automated monitoring unit located approximately 1 mile north-west of the test site (prevailing winds are from the southeast). Analysis will include continuous measurement of sulfur dioxide, hydrogen sulfide, total hydrocarbons and methane. Meteorological data from continuous recorders shall include wind speed, wind direction, temperature and precipitation. In the event of significant atmospheric pollutant emissions, dispersion characteristics will be determined.

Analytical procedures for air quality monitoring will be consistent with designated Reference or Equivalent Methods published by the U. S. Environmental Protection Agency, Monitoring and Research Laboratory, Research Triangle Park, North Carolina, November 3, 1978. Analyzer performance shall conform to specifications for automated methods as described in 40 CFR, Parts 50 and 53.

2. Water Quality

Water quality baseline studies will be conducted to determine:

- (1) ambient water quality conditions in local bayous and canals and in shallow ground water prior to possible disturbance from test well activities;
- (2) baseline conditions for substances potentially present in the geopressured fluids; and
- (3) water resource usage and baseline concentrations for substances and physical properties for which state standards have been established.

Water quality monitoring studies will be performed so that changes in chemical and physical properties of surface and ground water can be determined. Surface water samples will be collected monthly; surface water levels will be recorded at the time of sample collection. Laboratory analyses to be conducted for each sample will include Na, K, NH_3 , SO_4 , Cd, Mn, Ca, Cl, Ba, Pb, As, B, Hg, total hardness (calculated), and total organic carbon. Field measurements shall include pH, specific conductance, turbidity, temperature and dissolved oxygen.

Two observation wells will be drilled approximately 200 feet into the zone of fresh ground water. Ground-water samples will be collected each month. Field and laboratory analyses to be performed on ground-water samples will be the same as for surface waters. Water level in the observation wells will be reported monthly.

Ground and surface sample collection, handling, preservation and analysis will be consistent with methods published by the U. S. Environmental Protection Agency, "Manual of Methods for Chemical Analyzers of Water and Wastes" (1974), and the U. S. Geological Survey, "Recommended Methods for Water Data Acquisition" (1977).

3. Subsidence

Subsidence baseline studies will include an initial leveling survey to establish relative surface elevations, and an examination of historic leveling data and topographic maps to determine subsidence history in the vicinity of the test well.

The initial leveling survey shall consist of approximately 16.5 miles of First-Order precise leveling. Leveling profiles will be tied to National Oceanic and Atmospheric Administration (NOAA) elevation benchmarks which are located beyond the area of potential subsidence impact. Procedures to be used in establishing benchmarks in the vicinity of the test well will be in accordance with guidelines provided in the NOAA publication, "Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys" (1978).

Subsidence monitoring will consist of first-order releveled surveys which will be conducted at 12-month intervals during production to document the occurrence of land-surface subsidence, if any, near the well site, or of differential surface movement along reactivated faults. First-Order releveled is planned during the second year environmental monitoring program, and is not considered in the base scope of work for this proposal.

4. Seismicity

Microseismic surveys will be performed to:

- (1) determine background microseismic activity prior to disturbance from fluid production, and
- (2) monitor microseismic activity during fluid production. Baseline microseismic studies will include an initial reconnaissance survey to determine sources and levels of background microseismic activity. Data from this survey will be used to identify locations for permanent monitoring installations which will be least influenced by natural and cultural background noise.

Continuous microseismic monitoring will be performed using seismometers emplaced in sealed boreholes at approximately 4 feet below ground surface. Microseismic monitoring studies will provide the origin time of local seismic events, their estimated locations, and their relative magnitudes. The microseismic monitoring net will be operative approximately six months prior to fluid production.

5. Ecosystem Quality

Baseline ecological studies will rely on existing published and unpublished data to establish ranges and populations of plant and animal species in the vicinity of the test well. Additional biological surveys will be conducted in the event of significant impact to plant or animal life but are not considered part of the base scope of work.

C. Environmental Program Management

The environmental monitoring program will be managed by Dr. Charles G. Groat, Director of the Louisiana Geological Survey and Professor of Geology, Louisiana State University. The management of environmental monitoring will include insuring that data collected is compiled, analyzed, and reported to the U. S. Department of Energy (DOE) on a quarterly basis, or more frequently, if necessary. LSU will provide for contractual arrangements with firms for performance or selected field and laboratory studies. Overall data interpretation and impact assessment will be performed by LSU investigators. LSU will also be responsible for determining if federal, state, and local environmental quality standards are being met, and will inform DOE in the event of non-compliance. LSU investigators will also inform DOE when an increase or decrease in baseline monitoring studies are required, justifying such changes in scope as they occur.

This Environmental Monitoring Plan outlines a one-year program of combined environmental monitoring and baseline studies. LSU will prepare quarterly status reports, including data summaries, and an annual report summarizing the results obtained during the first year. Based on analysis of the data, the development of the test well, and federal, state, and local regulations, LSU will propose a second year plan for continuing air quality, water quality, subsidence and microseismic monitoring studies. In preparing this plan, LSU will determine whether or not it can be accomplished at a reduced level in any of the monitoring programs (e.g., increasing the interval between water samples, reducing the number of ions analyzed, increased level of air quality monitoring, etc.)

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APPENDIX A

DRILLING & EQUIPMENT

SUMMARY

DRILLING AND EQUIPMENT
SUMMARY

A. Production Well

1. Well Design

The initial well design submitted in the Dow Proposal No. 3791374 was modified at the request of the Department of Energy after the signing of the contract. The final well plan approved by the D.O.E. follows:

THE L. R. SWEETZ #1 WELL

(GEOPRESSURE - GEOTHERMAL TEST WELL)

GENERAL WELL PLAN

Location: 1800' FSL & 1350' FWL

Section 26, T 11 S, R 4 E

Vermilion Parish, Louisiana

Proposed Total Depth: 13,600'

Projected Spud Date: Nov. 1980

Objective Zone of Interest: "Cib-Jeff"

Conductor Casing: 30" (with sub-sea type hanger ring)

driven to 150' ± penetration. 30"

to be Grade B with a wall thickness

1.5" on top. Equipped with guide

show and each joint be welded

together.

Hole Size: 17½", opened to 24"

Surface Casing: 16" set at 5000'. Cement back to surface.

Hole Size: 14-3/4"

Protection Casing: 10-3/4" set at 12,600' ± (or in a 12.5 #/gal equivalent pore pressure).
Cement back to 7600' ± (or 5000' fillup).

Hole Size: 9½"

Completion Casing: Combination 8-5/8" / 7-5/8" to be set at 13,600'.

Inclination Surveys:

<u>Interval</u>	<u>Maximum Deviation</u>
0 - 5000'	Every 500' - Maximum allowable deviation from vertical 1°.
5000 - 12600' ±	Every 500' - Maximum allowable deviation from verticle 5°.

MultiShot Surveys:

- 1st Survey from surface to 5000'
- 2nd Survey from 5000' to 12,600'
- 3rd Survey from 12,600' to 13,600' ±

Coring: 100' ± from 13,360' to 13,460' ± utilizing a rubber sleeve core barrel assembly.

Special Drilling Fluid Consideration:

1. Maximum mud weight anticipated - 17.2#/gal.
2. API fluid loss to be maintained at no higher than 2cc - 3cc below 10-3/4" casing setting depth.

Logging:

<u>Interval</u>	<u>Log</u>
0 - 5000'	Gamma Ray/ISF Sonic - other as directed.
5000' - 12,600'	Gamma Ray/ISF Sonic - others as directed. Temperature Survey (after 10-3/4" casing set to determine top of cement and recalculate required overpull)
12,600' - 13,600'	ISF/Sonic - others as directed.

Completion: As directed.

Blowout Prevention Equipment:

Minimum Configuration Blowout Preventers.

Surface Casing (16")

- 3 - 16-3/4" 5000 psi Ram Type Preventer
- 1 - 16-3/4" 5000 psi Bag Type Preventer
- 1 - Remote Control HCR Type valve on choke line
- 1 - Drilling Spool oriented as surface casing

- 1 - Full opening safety valve to fit drill pipe and drill collars
- 1 - Inside blowout preventer to fit drill pipe and drill collars

Intermediate Casing (10-3/4")

- 3 - 11", 10,000 psi Ram Type Preventer
- 1 - 10", 5000 psi Bag Type Preventer
- 1 - Remote Control HCR Type valve on choke line
- 1 - Drilling Spool oriented on intermediate casing
- 2 - Full opening safety valve to fit drill pipe and drill collars
- 1 - Inside blowout preventer to fit drill pipe and drill collars

Choke and Manifold

A remote-control, hydraulic choke is to be installed at rig up on 16".

Casing Specifications:

16" Casing Design

Interval

0 - 5000'

Specifications

16", 109#/ft, K55, Buttress

Regular clearance couplings R-3,

Amalog IV Inspected.

10-3/4" Casing Design

<u>Interval</u>	<u>Specifications</u>
0 - 5500'	10-3/4", 55.5#/ft, S95, Buttress Thread
5500' - 8400'	10-3/4", 55.5#/ft, P110, Buttress Thread
8400' - 12600'	10-3/4", 55.5#/ft, S95, Buttress Thread, Amalog IV Inspected

8-5/8" / 7-5/8" Casing Design

<u>Interval</u>	<u>Specifications</u>
0 - 11000'	8-5/8", 44# P110 ABCFL4S
11000 - 13600'±	7-5/8", 39# P110 LT&C

2. Drilling History

The well was drilled according to plan with only minor problems, until total depth was reached on April 11, 1981. After clean-up, logging, and conditioning, the drill string was being layed down on April 14. With string still in the hole, the tongs were allowed to catch on the drill pipe, breaking it and dropping 2463 feet of drilling assembly and drill pipe to the bottom of the hole. The falling string was later found to have fractured the formation at 12,850 feet.

Fishing operation recovered all but 301 feet of drilling assembly consisting of a crossover, nine drill collars, three stabilizers, a bit sub and a 9½ rotary bit. The hole was sidetracked at 13,215 feet and drilled to 13,328 feet with a dynadrill. Reentry with a 9½" rotary bit resulted in hitting the top of the fish at 13,301 feet, thus losing the sidetrack. A second attempt was successful from 13,064 feet to 13,605 feet. This new hole was logged and conditioned.

While running the 8-5/8" - 7-5/8" tapered casing string, the casing threads parted five points below the rotary table and 262 joints of casing plus the polished bore receptacle assemble fell to the bottom.

Top of the fish was at 547 feet. All but the bottom 800 feet was fished out. A second sidetrack was started at 12,721 feet and drilled to 13,612 feet. This hole was cased as planned except that the partial loss of 8-5/8" casing required the polished bore receptical and the 8-5/8" - 7-5/8" crossover to be located at 11,451 feet rather than the planned 11,000 feet. The detail of the casing, cementing and other operations are shown in Figures A-1 and A-2 of this Appendix.

A problem developed with the cementing of the tapered string. For reasons unknown, the well began to flow in the 10-3/4" - 8-5/8" annulus before the cement set. The well was closed in after an estimated flow of 50 bbls. of mud from the annulus. Pressures up to 3300 psi were observed at the surface. Stretch calculation on the 8-5/8" casing, made later, indicated cementing at 670 feet rather than the expected 4000 feet.

The annulus was plugged with a "Barite Pill" and the surface pressure returned to zero. In the course of the operations, it was determined that there was indeed a formation fracture at 12,850 feet which took fluid at 300 psi pump pressure with 17.2 ppg mud. A noise log indicated no flow from the target sand with the well closed in. Temperature logs tended to indicate that flow had occurred from the sand up the outside of the tapered string and produced the flow from the annulus.

Block squeezes through perforations in the 7-5/8" casing at the top and bottom of the target sand (see Figure A-1) successfully sealed off the flow interval.

3. Completion

After a cement Bond Log indicated sufficient zone isolation, the block squeezes were pressure tested and differentially tested. The drilling mud was then displaced with a calcium Bromide/Zinc Bromide completion fluid. The wellbore was circulated and cleaned until all particles, 5 microns and larger were filtered out. The "Cibb-Jeff" Sand was perforated at 12,349' - 388' and 13,395' - 406' Dual Induction Log measurements. The zone was perforated with 12 shots per foot with Schlumberger's 4" Big Hole casing jet. A T.I.W. Model 'SS' packer with a knockout plug was set at 13,422'. The perforations were successfully washed with a Dowell cup-type perforation washing tool. However, several drag springs off of the wash tool were lost in the hole.

The perforated interval was acidized with 3000 gallons 15% HCl and 6000 gallons 12.3 Regular Mud Acid. The planned pre-pack gravel-pack was not attempted because of severe lost returns following the acid. A mule shoe with collet and

seal unit were run to push the drag springs lost earlier and Knock-out plug through the packer at 13,422 feet. The Packer was tested with 100 psi.

The gravel-pack assembly w/BHP bomb latching nipple, 4", .012 gauge screen and Dowell Model 16 GP Packer was run in the hole. The packer was set at 13,143 feet and tested w/3500 psi. The "Cibb-Jeff" Sand was gravel-packed with 20 Bbls Dowell Water Pack Slurry w/7600 lbs., 20/40 Mesh Re-Sieved Ottawa Sand. Final Sand out was w/5000 psi. Reversed with 8.5 Bbls of Slurry leaving 1330 lbs. of 20/40 mud sand in formation and 3040 lbs. in Annulus between screen and casing.

The Polished Bore Receptical (PBR) run previously with the 8-5/8 / 7-5/8" casing was honed and tested at 4000 psi. The PBR location seal assembly and other completion equipment was run into hole with 262 jts. of 5 1/2", 23#/ft, S-95, LT&C modified and internally coated tubing. All connections were internally tested at 9000 psi prior to running. See Figure A-3 for completion details.

The seals were located in the PBR @ 10,451 feet and tested at 5000 psi. After testing the seals, could not be pulled out of the PBR. A special wireline standing valve was built and set in the Model 16 packer at 13,143 feet and the seals hydraulically pumped out of the PBR. After circulating the well, the seals were worked into the PBR and tested with no problems. The tubing was spaced out, the FMC tubing hanger installed and the hanger landed in the tubing head at 2130 hours August 14, 1981. The seals were again tested at 5000 psi.

The special standing valve was removed from the packer at 13,143 feet and an Otis 'DR' plug set at 383 feet. A FMC 5" Back Pressure Valve was installed in the tubing hanger and the 10,000 psi blow-out preventors were nipped down. A temporary FMC 3-1/16", 10,000 psi Dry Hole tree was installed and tested at 9000 psi.

The drilling rig, Welsh Rig 17, was released by Dow Chemical at 0800 hours August 16, 1981. Rig down and move out was complete on August 26, 1981.

B. Disposal Well

1. General

The disposal well should have the capacity to dispose of 720,000 bpd for a period of more than one year. It is not anticipated that a second well will be required for the program and it will not be drilled unless absolutely necessary.

Disposal aquifers are abundant and of excellent quality in Parcperdue field. Sands are massive throughout the entire Miocene section and comprise more than 50 percent of the interval, which roughly ranges from near surface to approximately 10,000 feet.

The well will be drilled to a total depth of 5,000 feet. The log of the Production Well, Dow/DOE L. R. Sweezy No. 1 (see Figure A-4) indicates a thick sand available with disposal potential. The proposed injection zone should correlate to 4,533 - 4,685 feet, with the L. R. Sweezy No. 1 well.

Porosity in the recommended zone is greater than 30%. Shallow and deep resistivity curves exhibit separation, indicating good permeability. The zone is wet. The conditions should make for an ideal disposal sand with outstanding injectability and excellent lateral continuity. Base of fresh or brackish water is at approximately 1600 feet.

2. Drilling Procedure

The schematic well design is shown in Figure A-5.

The drilling procedure will be as follows:

- a. Location will be staked, permits obtained, and necessary forms filed.
- b. Site will be prepared.
- c. Rig will be moved in.
- d. A 16-inch conductor casing will be driven to $\pm$ 120 feet. A 13 $\frac{1}{2}$ -inch hole will be drilled to 2,700 feet, with a 10 $\frac{3}{4}$ -inch surface casing set and cemented to the surface. The surface casing will protect all possible freshwater sands. A cement bond log will be run to verify good cementing.
- e. A 9 $\frac{1}{2}$ -inch hole will be drilled to 5,000 feet TD.
- f. A 7 inch casing string will be set at 5,000 feet and cemented to the surface. The disposal zone will be perforated.
- g. Nipple down BOPs, nipple up 6-inch injection tree.
- h. Rig down and move out.

- i. Flow to pit, clean up hole and acidize.
- j. Install downhole pressure recorder. Perform injection test at ± 15 bpm.
- k. Hook up injection well to surface facilities.

DOW CHEMICAL / D.O.E.
L.R. SWEETZ NO.1
CASING DETAIL

Rotary Table

25.67'

BHF - 16", 5,000 PSI

16", 109#/ft., K-55, BTRC @ 5048'
Cmt'd w/9000 sxs - Dowell lightweight @ 12.0 ppg. Tailed w/500 sxs - Class "H" + 35% D-30 + D-60 + .2% D-46
No cement returns. Top out w/500 sxs - Class "H" + 3% CaCl₂
Squeezed shoe w/400 sxs - Class "H" + 0.15% D - 13 @ 16.2 ppg.

8 5/8", 44#/ft., P-110, AB FL-4S surface - 10,451'

T.I.W. 8" OD x 6 3/4" ID x 27' long polished bore receptical @ 10,451'.
8 5/8", 44#, FL-4S Box x 7 5/8", 39#, LT & C pin.

10 3/4", 55.5#/ft., BTRC @ 12,712'
AR-95 surface - 5264
P-110 5264' - 8435'
AR-95 8435' - 12,712'
Cmt's w/3118 sxs - Class "H" + 35% D-30 + 1% D-60 + 0.1% D-13 + 0.2% D-46 @ 16.2 ppg
Top of cement by CBL - 6300'
Shoe did not test
Squeezed shoe w/200 sxs - Class "H" + 0.1% D-28 + 0.2% D-46 @ 16.2 ppg.

Dry tested after squeezing w/12.5 ppg equivalent

Note 2: Parts of three (3) cement retainers may be at PBTD in 7 5/8".

Note 3: A chain hook is in bottom of open hole below 7 5/8".

NOTE 1: Completion is in sidetrack NO. 2. Original hole lost when 4 1/2" drill pipe was dropped. TOF @ 13,301'. Sidetrack No. 1 was lost when 8 5/8" casing parted. TOF 12,800'. Sidetrack No. 2 is north of both previous holes.

Dow Chemical/DOE
L.R. Sweetz No. 1
Casing Detail
Spud 1-5-81
Production Casing Set
6-25-81

7 5/8", 39#, LT & C 10,484 - 13,608
C-95 10,484' - 11,059
P-110 11,059 - 13,608
cmt'd w/370 sxs - Class "H" + 35% 10#/sx D-18 + .42 gal/sx D-108 + .2% D-28 + D-46 @ 17.4 ppg WOC 18 hrs.
Top job on 10 3/4" x 8 5/8" annulus w/330 sxs - Class "H" + 35% D-30 + 10#/sx D-18 + .42 gal/sx D-108 + .2% D-28 + .2% D-46 @ 17.4 ppg.
300 sxs - Class "H" + 35% D-30 + .5% D-65 + .2% D-13 + .2% D-46 @ 16.8 ppg tailed w/220 sxs - Class "H" + 35%

Block squeezed @ 13,342 - 344' CBL - Squeezed w/150 sxs Class "H" into formation Tested w/23.9 ppg equivalent

Cib Jeff" Sand perforations 13,349' - 388' & 13,395 - 406' DIL w/12 SPF w/4" Big Hole casing Jet @ 90° @

Block squeeze @ 13,412 - 414' CBL - Squeezed w/57 sxs in formation. Failed to test. Re-squeezed w/90 sxs in formation. Tested w/23.5 ppg equivalent.

PBTD @ 13,534'
TD @ 13,612'

BY: C.A. Bell
8/24/81

CAB/ne

DOW CHEMICAL/D.O.E.
L.R. SWEET NO. 1
WELLBORE AND COMPLETION SCHEMATIC

Figure A-2
A-11

CAB 8/25/81

TEMPORARY
FMC 3 1/16", 10,000
DRY - HOLE TREE

DOW CHEMICAL/D.O.E.
L. R. SWEETZ NO. 1
GRAVEL-PACK AND COMPLETION DETAIL

ITEM	DESCRIPTION	O.D. (IN)	I.D. (IN)	LENGTH (FT)	TOP (FT)
TUBING					
	Elevation (Rotary to THF)			20.75	00
1	FMC 9" x 5 1/2" TCM Tubing Hanger			.88	20.75
2	1 jt, 5 1/2", 23#/ft, S-95, LT&C Mod. Tbg. Internally coated w/TK-2C	5.50	4.54 (drift)	39.80	21.63
	5 Pup Jts., 5 1/2", 23#/ft, S-95, Mod. Tbg. Internally coated w/TK-2C	5.50	4.54	10.05 8.09 6.07 4.10 2.52	61.43
	7 jts. 5 1/2" tbg. as above	5.50	4.54	281.13	92.26
3	Otis Flow Coupling 5 1/2", BXB LT&C Mod.	6.10	4.78	10.00	373.39
4	Otis 'R' Landing Nipple, PXP	5.50	4.313	1.03	383.39
5	254 Jts., 5 1/2" Tbg. as above			10,049.42	384.42
6	Otis Flow Coupling, 5 1/2", BXB LT&C Mod	6.10	4.78	9.98	10,433.74
7	Otis 'RN' Landing Nipple	5.50	3.986	1.15	10,443.72
--	T.I.W. Seal Ass. Serial No. 14553				
8	Locator	7.00		1.02	10,444.87
9	Spacer	5.50		3.43	10,445.89
10	Seals-T.I.W. Riton Packing (15 units)	6.75		25.90	10,449.32
11	Mule Shoe End of Tubing	6.68	4.68	1.40	10,475.22 10,476.62
NOTE: Locator is spaced-out 5' above PBR.					
12	8 5/8", 44#/ft, P-110, FL-4S casing surface to 10,450.89'.				
--	T.I.W. Polished Bore Receptical Serial No. 14812				
13	X-Over 8 5/8", 44#, FL-4S x 7 5/8", LT&C PIN.	8.625	6.81	4.25	10,450.89
14	Polished Bore Receptical	8.00	6.75	27.64	10,455.14
15	Extension 7 5/8" LT&C	8.25	6.75	1.40	10,482.78
16	7 5/8", 39#/ft, C-95 & P-110, LT&C Csg 10,484.18' to 13,608.96'.				
GRAVEL-PACK					
17	Dowell Model 16 GP Packer w/port- closing sleeve	6.437	3.25	8.03	13,143.16
18	6 jts. 4", 13.40 #/ft blank w/weld-on centralizers each 15'.	4.00	3.428	28.23 28.28 28.71 28.72 27.56 28.75	13,151.19
19	3 jts. 4", .012 gauge Stainless Steel All-welded screen (Howard Smith) w/ weld-on Centralizers each 15'.	4.545	3.428	29.80 29.94 29.72	13,321.44
20	Wash Pipe Seal Bore Sub	4.75	2.78	1.30	13,410.90
21	Tattle-Tale screen 4", .012 gauge Stainless Steel All-Welded	4.545	3.428	8.52	13,412.20
22	X-Over 4", NU x 2 7/8, 8RD	4.47	2.44	.58	13,420.72
23	Locator		2.44	.70	13,421.30
24	Collet/Seal Assembly (4 seal units)	3.25		3.54	13,422.00
25	X-Over 2 7/8 FL x 2 7/8 DSS-HT	3.22	2.44	.50	13,425.54
26	1 jt., 2 7/8", 6.5#/ft, DSS-HT Tubing	3.22	2.44	32.69	13,426.04
27	Otis 'XN' Landing Nipple 2 7/8", DSS-HT, BXP	3.22	2.205	.93	13,458.73
28	Production Tube w/mule shoe End of Tubing	3.22	2.44	3.90	13,459.66 13,463.56
29	T.I.W. Model 'SS' Packer		3.25	3.00	13,422.00

'CIBB JEFF' SAND - Perforated 13,349'-388' & 13,395' - 406' DIL Run 5 dated 6-22-81
w/12 SPF w/ 4" Big Hole Jet. Gravel-Packed w/ 20/40 Mesh Sand -- 1330 lb. in
formation & 3040 lb. in Annulus

Final Completion & Packer Fluid -- 17.2 ppg @ 60°F CaBr₂/ZnBr₂

Minimum Restrictions: Tubing - 'RN' Nipple @ 10,444' - 3.986"
Gravel-Pack - 'XN' Nipple @ 13,459' - 2.205"

NOTE: Tubing has 4.313" 'DR' Plug set @ 383' and A 5" BPV set @ surface.

CAB 9/5/81

Figure A-3
A-12

ELECTRICAL LOG SECTION
from
DOW/DOE L. R. SWEETZ NO.1
VERMILION PARISH, LOUISIANA

Salt Water Disposal Well #1
Proposed Injection Zone
Parcperdue Project
FIGURE A-4

PROPOSED COMPLETION SCHEMATIC
Dow Chemical U.S.A.
Parcperdue Project SWD Well

± NOT TO SCALE

FIGURE A-5
A-14

APPENDIX B

**ACID SOLUBILITIES
and
SIEVE ANALYSES
of
PRODUCTION ZONE SAND**

DOW/D.O.E. L.R. SWEEZY NO.1

DOWELL DIVISION OF DOW CHEMICAL U.S.A.

Report No.: 810003

May 5, 1981

Dow Chemical
Sweezy #1
Vermilion, Louisiana

Originator: Dave Swoffer
Lafayette, Louisiana

W. H. Bolivar - Chemist
Dan Maxwell - Lab Assistant

Distribution:

Lafayette Lab (2)
Regional Engineering Manager (1)
Ron Thomas (1)
Dave Swoffer (2)

Requested Information

Analysis of formation samples have been requested for purpose of preparing sand control recommendations. The analysis should specifically include acid solubilities and sieve analysis.

Sample Grouping Procedure

Submitted samples were cleaned formation samples and should be representative of zones of interest. In order to have adequate and representative samples to work with, we combined portions of each sample thought to be representative of a particular sand segment. Samples for acid solubilities were prepared in approximately ten foot intervals and include both clay and sand segments. Sieve analysis samples were prepared only on those thought to be representative of sand segments.

Acid Solubility Tests

These tests were run gravimetrically. One gram samples were placed in 100 ml of 15x and Mud Acid and heated for one hour at 150°F. The residue was filtered, dried and weighed. The amount of soluble material was then calculated and is reported as per cent by weight.

<u>Depth</u>	<u>Percent Solubility</u>	
	<u>15x</u>	<u>Mud Acid</u>
13,340.5	4.7	63.6
13,342.5	4.0	15.0
13,346.5	1.3	31.7
13,352.7	1.9	11.0
13,360.5	9.4	15.8
13,365.5	1.7	9.1
13,370.5	1.6	16.1
13,375.5	1.4	11.8
13,380.9	8.0	47.2
13,381.5	11.2	66.5
13,390	3.6	21.9

Acid Solubility Tests (cont)

<u>Depth</u>	<u>Per Cent Solubility</u>	
	<u>15x</u>	<u>Mud Acid</u>
13,394.5	3.9	31.1
13,395.2	4.6	63.4
13,397.5	6.2	15.7
13,400	10.6	45.1
13,405	6.3	38.9
13,410	11.7	66.8
13,415	12.7	53.9
13,418	12.7	59.9
13,419	9.6	53.5
13,420	13.6	61.9
13,425	14.2	63.0
13,430	11.2	63.5
13,435	11.9	66.3
13,438	10.2	64.3
13,450	15.8	52.4
13,456	15.3	67.7
13,460	15.4	68.2
13,491	12.8	70.9

Sieve Analysis

Sieve Analysis was run using screens sized according to the U. S. Standard Sieve Series. Approximately 50-75 grams of sample were placed on the top screen, the stack of screens was then placed on a Tyler Shaker and shaken for 15 minutes. The amount of sample retained on each screen was recorded and is presented below as the per cent of the total sand weighed back.

Depth 13,342.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	16.4	21.2	21.2
70	48.7	63.1	84.3
100	12.0	15.5	99.8
140	0.1	0.2	100.0
200	0.0	0.0	100.0
270	0.0	0.0	100.0
Pass	0.0	0.0	100.0

Depth 13,346.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	4.0	6.3	6.3
70	27.7	44.0	50.3
100	27.4	43.5	93.8
140	2.4	3.8	97.6
200	1.0	1.6	99.2
270	0.5	0.8	100.0
Pass	0.0	0.0	100.0

Depth 13,352.7

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	3.5	5.4	5.4
70	21.6	33.4	38.8
100	33.7	52.1	90.9
140	4.7	7.3	98.2
200	1.0	1.5	99.7
270	0.2	0.3	100.0
Pass	0.0	0.0	100.0

Depth 13,360.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	18.8	24.1	24.1
70	35.6	45.7	69.8
100	21.3	27.3	97.1
140	1.6	2.1	99.2
200	0.4	0.5	99.7
270	0.2	0.3	100.0
Pass	0.0	0.0	100.0

Sieve Analysis (cont)

Depth 13,365.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	9.8	16.6	16.6
70	19.4	32.9	49.5
100	22.5	38.2	87.7
140	6.0	10.2	97.9
200	1.00	1.7	99.6
270	0.2	0.4	100.0
Pass	0.0	0.0	100.0

Depth 13,370.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	13.1	17.9	17.9
70	39.7	54.2	72.1
100	17.7	24.2	96.3
140	1.4	1.9	98.2
200	1.1	1.5	99.7
270	0.2	0.3	100.0
Pass	0.0	0.0	100.0

Depth 13,375.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	1.7	2.9	2.9
70	11.4	19.4	22.3
100	40.5	68.9	91.2
140	3.4	5.8	97.0
200	1.5	2.6	99.6
270	0.3	0.4	100.0
Pass	0.0	0.0	100.0

Depth 13,380.9

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	5.4	10.6	10.6
70	15.8	31.1	41.7
100	15.7	30.9	72.6
140	4.2	8.3	80.9
200	3.5	6.9	87.8
270	5.2	10.2	98.0
Pass	1.0	2.0	100.0

Sieve Analysis (cont)

Depth 13,390

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	5.6	9.8	9.8
70	3.3	5.6	15.4
100	17.4	29.7	45.1
140	8.5	14.5	59.6
200	18.3	31.2	90.8
270	4.5	7.7	98.5
Pass	0.9	1.5	100.0

Depth 13,394.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	4.7	7.6	7.6
70	3.1	5.0	12.6
100	13.9	22.3	34.9
140	13.5	21.7	56.6
200	18.8	30.2	86.8
270	6.6	10.6	97.4
Pass	1.6	2.6	100.0

Depth 13,397.5

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	6.9	8.4	8.4
70	11.5	14.0	22.4
100	28.5	34.6	57.0
140	11.0	13.3	70.3
200	18.8	22.8	93.1
270	5.0	6.1	99.2
Pass	0.7	0.8	100.0

Depth 13,405

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	8.5	15.0	15.0
70	4.1	7.2	22.2
100	20.7	36.6	58.8
140	10.0	17.7	76.5
200	8.2	14.5	91.0
270	3.8	6.7	97.7
Pass	1.3	2.3	100.0

Sieve Analysis (cont)

Depth 13,419

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	12.8	24.4	24.4
70	8.7	16.6	41.0
100	15.3	29.1	70.1
140	4.4	8.4	78.5
200	2.3	4.4	82.9
270	5.5	10.5	93.4
Pass	3.5	6.6	100.0

Depth 13,438

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	15.7	36.7	36.7
70	10.6	24.8	61.5
100	8.5	19.8	81.4
140	2.1	4.9	86.3
200	1.9	4.4	90.7
270	3.6	8.4	99.1
Pass	0.4	0.9	100.0

Depth 13,450

<u>Screen #</u>	<u>Mass</u>	<u>% Retained</u>	<u>% Cumulative</u>
50	13.3	29.0	29.0
70	7.9	17.2	46.2
100	10.8	23.6	69.8
140	2.6	5.7	75.5
200	4.1	9.0	84.5
270	5.8	12.7	97.2
Pass	1.3	2.8	100.0

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

ENERGY #1
 DEPTH - 13,365 S
 50% = 0.0082

U.S. S. No.	Particle Size (Inches)
50	15
70	50
100	100
140	200
200	400

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

LOGARITHMIC PROBABILITY PLOT OF SCREEN ANALYSIS

APPENDIX C

SUB-SURFACE DIRECTIONAL
SURVEY

Dow/D.O.E. L. R. Sweezy No. 1

**REPORT
of
SUB-SURFACE
DIRECTIONAL
SURVEY**

DOW CHEMICAL COMPANY
COMPANY

L.R. Sweezy Well No. 1
WELL NAME

Parc Perdue Field
LOCATION

JOB NUMBER
LA 781 G 0934

TYPE OF SURVEY
Gyroscopic

DATE
7/10/81

SURVEY BY
Lafayette, LA

OFFICE

DOW CHEMICAL CO.
L.R. SWEZY WELL NO. 1
PARC PERDUE FIELD

EASTMAN WHIPSTOCK INC
MAGNETIC MULTISHOT SURVEY

RECORD OF SURVEY

RADIUS OF CURVATURE METHOD

DOW CHEMICAL CO.
L.R. SWEETZ WELL NO. 1
PARC PERDUE FIELD

COMPUTATION PAGE NO. 1
TIME DATE
08:59:33 10-JUL-81

MEASURED DEPTH FEET	DRIFT ANGLE D M	DRIFT DIRECTION D	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET	DOGLEG SEVERITY DG/100FT
0.	0 0	0	0.	0.00	0.00 0.00	0.00
302.	0 0	0	302.	302.00	0.00 0.00	0.00
353.	0 15	N 53 E	51.	353.00	0.07 N 0.09 E	0.49
444.	0 15	N 70 E	91.	444.00	0.26 N 0.44 E	0.08
536.	0 15	N 19 E	92.	536.00	0.53 N 0.71 E	0.23
627.	0 15	S 75 E	91.	627.00	0.70 N 1.03 E	0.37
719.	0 15	N 16 W	92.	719.00	0.94 N 1.26 E	0.47
810.	0 15	S 80 W	91.	810.00	1.13 N 0.95 E	0.37
902.	0 0	0	902.	902.00	1.00 N 0.75 E	0.27
993.	0 0	0	91.	993.00	1.10 N 0.75 E	0.00
1084.	0 0	0	91.	1084.00	1.10 N 0.75 E	0.00
1176.	0 30	S 69 W	92.	1175.99	0.95 N 0.38 E	0.54
1267.	0 15	N 6 E	91.	1266.99	1.25 N 0.02 W	0.72
1359.	0 0	0	92.	1358.99	1.45 N 0.01 E	0.27
1450.	0 15	S 87 W	91.	1449.99	1.44 N 0.19 W	0.27
1542.	0 15	N 39 W	92.	1541.99	1.54 N 0.58 W	0.16
1633.	0 30	N 62 E	91.	1632.99	2.03 N 0.56 W	0.73
1725.	0 15	S 31 E	92.	1724.99	1.88 N 0.04 W	0.59
1816.	0 45	N 35 E	91.	1815.98	1.86 N 0.63 E	0.97
1908.	0 0	0	92.	1907.98	2.35 N 0.98 E	0.82
1999.	0 30	N 45 W	91.	1998.98	2.63 N 0.70 E	0.55
2091.	0 15	N 69 E	92.	2090.98	3.13 N 0.80 E	0.70
2182.	0 15	S 39 E	91.	2181.98	3.04 N 1.16 E	0.32
2274.	0 15	N 66 E	92.	2273.98	2.95 N 1.53 E	0.33
2365.	0 15	N 85 W	91.	2364.97	3.24 N 1.48 E	0.53
2457.	0 15	S 15 E	92.	2456.97	2.97 N 1.26 E	0.45
2548.	0 15	N 72 E	91.	2547.97	2.80 N 1.57 E	0.40
2640.	0 0	0	92.	2639.97	2.87 N 1.76 E	0.27
2731.	0 15	N 85 W	91.	2730.97	2.88 N 1.56 E	0.27
2823.	0 30	N 21 E	92.	2822.97	3.33 N 1.29 E	0.67

C-3

Eastman
Whipstock
PETROLEUM COMPANY

DOW CHEMICAL CO.
L.R. SWEETZ WELL NO. 1
PARC PERDUE FIELD

COMPUTATION PAGE NO. 2
TIME DATE
08:59:33 10-JUL-81

MEASURED DEPTH FEET	DRIFT ANGLE D M	DRIFT DIRECTION D	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	RECTANGULAR COORDINATES FEET		DOGLEG SEVERITY DG/100FT
2914.	0 15	S 2 E	91.	2913.97	3.26 N	1.71 E	0.81
3005.	0 0	0	91.	3004.97	3.06 N	1.71 E	0.27
3097.	0 30	S 69 W	92.	3096.97	2.91 N	1.34 E	0.54
3188.	0 15	N 85 E	91.	3187.96	2.51 N	1.43 E	0.82
3280.	0 15	N 70 W	92.	3279.96	2.80 N	1.47 E	0.53
3371.	0 15	N 89 W	91.	3370.96	2.87 N	1.08 E	0.09
3463.	0 15	S 90 E	92.	3462.96	3.13 N	1.08 E	0.54
3554.	0 15	N 10 W	91.	3553.96	3.39 N	1.31 E	0.42
3646.	0 45	S 77 E	91.	3645.96	3.86 N	1.80 E	0.95
3737.	0 45	S 59 E	91.	3736.95	3.42 N	2.90 E	0.26
3829.	0 30	S 85 E	92.	3828.94	3.00 N	3.85 E	0.40
3920.	0 30	S 41 E	91.	3919.94	2.76 N	4.54 E	0.41
4012.	0 30	S 5 E	92.	4011.94	2.03 N	4.84 E	0.34
4103.	0 15	N 72 E	91.	4102.93	1.75 N	5.28 E	0.67
4195.	0 30	N 69 E	92.	4194.93	1.95 N	5.85 E	0.27
4286.	0 15	N 65 E	91.	4285.93	2.18 N	6.40 E	0.28
4378.	0 30	S 68 E	92.	4377.93	2.19 N	6.98 E	0.41
4469.	0 45	S 37 E	91.	4468.92	1.60 N	7.76 E	0.45
4561.	0 15	N 49 E	92.	4560.92	1.52 N	8.47 E	0.88
4652.	0 15	S 9 W	91.	4651.92	1.38 N	8.74 E	0.52
4744.	0 0	0	92.	4743.92	1.18 N	8.71 E	0.27
4835.	0 30	N 80 E	91.	4834.92	1.25 N	9.10 E	0.55
4927.	0 15	N 85 E	92.	4926.92	1.33 N	9.70 E	0.27
5018.	0 30	S 5 E	91.	5017.91	0.98 N	10.11 E	0.61

EASTMAN WHIPSTOCK GYRO SURVEY FROM THIS POINT 7/9/81

5100.	0 15	S 17 W	82.	5099.91	0.45 N	10.05 E	0.35
5200.	0 0	0	100.	5199.91	0.24 N	9.99 E	0.25
5300.	0 0	0	100.	5299.91	0.24 N	9.99 E	0.00
5400.	0 0	0	100.	5399.91	0.24 N	9.99 E	0.00

DOW CHEMICAL CO.
L.R. SWEETZ WELL NO. 1
PARC PERDUE FIELD

COMPUTATION PAGE NO. 3
TIME DATE
08:59:33 10-JUL-81

MEASURED DEPTH FEET	DRIFT ANGLE D M	DRIFT DIRECTION D	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	R E C T A N G U L A R C O O R D I N A T E S FEET		DOGLEG SEVERITY DG/100FT
5500.	0 0	0	100.	5499.91	0.24 N	9.99 E	0.00
5600.	0 0	0	100.	5599.91	0.24 N	9.99 E	0.00
5700.	0 0	0	100.	5699.91	0.24 N	9.99 E	0.00
5800.	0 0	0	100.	5799.91	0.24 N	9.99 E	0.00
5900.	0 0	0	100.	5899.91	0.24 N	9.99 E	0.00
6000.	0 15	N 26 E	100.	5999.91	0.44 N	10.08 E	0.25
6100.	0 0	0	100.	6099.91	0.63 N	10.18 E	0.25
6200.	0 0	0	100.	6199.91	0.63 N	10.18 E	0.00
6300.	0 0	0	100.	6299.91	0.63 N	10.18 E	0.00
6400.	0 30	S 15 W	100.	6399.91	0.21 N	10.07 E	0.50
6500.	0 45	S 33 W	100.	6499.91	0.86 S	9.85 E	0.26
6600.	0 15	S 33 W	100.	6599.90	1.67 S	9.55 E	0.53
6700.	0 30	S 24 W	100.	6699.90	2.24 S	9.23 E	0.26
6800.	0 45	S 55 W	100.	6799.89	3.08 S	8.55 E	0.41
6900.	1 0	S 66 W	100.	6899.88	3.83 S	7.22 E	0.30
7000.	1 30	S 76 W	100.	6999.85	4.53 S	5.16 E	0.54
7100.	2 0	S 79 W	100.	7099.81	5.20 S	2.18 E	0.51
7200.	1 45	S 81 W	100.	7199.75	5.76 S	1.05 W	0.26
7300.	1 45	S 79 W	100.	7299.71	6.29 S	4.05 W	0.06
7400.	1 45	S 75 W	100.	7399.66	6.98 S	7.03 W	0.12
7500.	1 15	S 73 W	100.	7499.63	7.70 S	9.54 W	0.50
7600.	1 30	S 79 W	100.	7599.60	8.28 S	11.87 W	0.29
7700.	1 15	S 79 W	100.	7699.57	8.74 S	14.22 W	0.25
7800.	1 15	S 89 W	100.	7799.54	8.97 S	16.39 W	0.22
7900.	1 15	S 66 W	100.	7899.52	9.44 S	18.51 W	0.50
8000.	1 0	S 65 W	100.	7999.50	10.25 S	20.29 W	0.25
8100.	1 15	S 56 W	100.	8099.48	11.22 S	22.00 W	0.31
8200.	1 0	S 24 W	100.	8199.46	12.70 S	23.25 W	0.67
8300.	0 45	S 33 E	100.	8299.45	14.16 S	23.13 W	0.86
8400.	1 15	S 34 W	100.	8399.44	15.81 S	23.15 W	1.18

C-5

Eastman
Whipstock

APETROBANE COMPANY

DOW CHEMICAL CO.
L.R. SWEETZ WELL NO. 1
PARC PERDUE FIELD

COMPUTATION PAGE NO. 4
TIME DATE
08:59:33 10-JUL-81

MEASURED DEPTH FEET	DRIFT ANGLE D M	DRIFT DIRECTION D	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	R E C T A N G U L A R C O O R D I N A T E S FEET		DOGLEG SEVERITY DG/100FT
8500.	1 15	S 19 W	100.	8499.41	17.76 S	24.12 W	0.33
8600.	1 0	S 10 W	100.	8599.39	19.66 S	24.61 W	0.31
8700.	1 15	S 21 W	100.	8699.37	21.55 S	25.13 W	0.33
8800.	1 45	S 1 W	100.	8799.34	24.10 S	25.63 W	0.72
8900.	1 30	S 11 E	100.	8899.30	26.92 S	25.38 W	0.42
9000.	1 45	S 10 E	100.	8999.26	29.71 S	24.87 W	0.25
9100.	3 30	S 28 E	100.	9099.15	34.02 S	23.38 W	1.91
9200.	4 15	S 32 E	100.	9198.92	39.88 S	20.00 W	0.80
9300.	4 45	S 29 E	100.	9298.61	46.64 S	16.02 W	0.55
9400.	5 0	S 27 E	100.	9398.25	54.14 S	12.03 W	0.30
9500.	5 0	S 26 E	100.	9497.87	61.87 S	8.01 W	0.09
9600.	4 45	S 29 E	100.	9597.51	69.33 S	3.96 W	0.26
9700.	4 15	S 32 E	100.	9697.20	76.09 S	0.03 E	0.55
9800.	3 45	S 31 E	100.	9796.96	82.04 S	3.67 E	0.50
9900.	3 30	S 37 E	100.	9896.76	87.28 S	7.21 E	0.45
10000.	2 30	S 26 E	100.	9996.62	91.74 S	9.94 E	1.15
10100.	2 30	S 24 E	100.	10096.52	95.69 S	11.78 E	0.09
10200.	2 0	S 30 E	100.	10196.45	99.19 S	13.56 E	0.55
10300.	1 45	S 15 E	100.	10296.39	102.20 S	14.81 E	0.55
10400.	2 0	S 18 E	100.	10396.34	105.34 S	15.74 E	0.27
10500.	0 45	S 25 E	100.	10496.31	107.57 S	16.62 E	1.26
10600.	1 15	S 32 E	100.	10596.29	109.11 S	17.45 E	0.51
10700.	0 45	S 8 W	100.	10696.28	110.78 S	17.81 E	0.83
10800.	1 15	S 6 W	100.	10796.26	112.51 S	17.59 E	0.50
10900.	0 45	S 4 W	100.	10896.24	114.25 S	17.44 E	0.50
11000.	1 0	S 27 W	100.	10996.23	115.71 S	17.04 E	0.43
11100.	0 45	S 11 W	100.	11096.22	117.15 S	16.54 E	0.35
11200.	0 30	S 14 W	100.	11196.21	118.21 S	16.31 E	0.25
11300.	0 30	S 21 E	100.	11296.21	119.07 S	16.36 E	0.30
11400.	1 0	S 10 W	100.	11396.20	120.36 S	16.48 E	0.63

C-6

DOW CHEMICAL CO.

L.R. SWEETZ WELL NO. 1

PARC PERDUE FIELD

COMPUTATION

PAGE NO. 5

TIME DATE

08:59:33 10-JUL-81

MEASURED DEPTH FEET	DRIFT ANGLE D M	DRIFT DIRECTION D	COURSE LENGTH FEET	TRUE VERTICAL DEPTH FEET	R E C T A N G U L A R C O O R D I N A T E S FEET		DOGLEG SEVERITY DG/100FT
11500.	0 45	S 18 E	100.	11496.19	121.86 S	16.59 E	0.49
11600.	0 45	S 48 W	100.	11596.18	123.06 S	16.27 E	0.82
11700.	0 45	S 16 W	100.	11696.17	124.15 S	15.58 E	0.41
11800.	0 30	N 52 W	100.	11796.17	124.44 S	14.70 E	1.05
11900.	0 45	S 68 W	100.	11896.16	124.29 S	13.67 E	0.66
12000.	0 30	S 20 W	100.	11996.16	125.06 S	12.94 E	0.56
12100.	0 30	N 84 W	100.	12096.15	125.48 S	12.25 E	0.62
12200.	0 30	S 33 W	100.	12196.15	125.84 S	11.50 E	0.52
12300.	0 45	N 69 W	100.	12296.14	126.15 S	10.54 E	0.81
12400.	0 45	S 66 W	100.	12396.13	126.17 S	9.27 E	0.57
12500.	0 0		100.	12496.13	126.48 S	8.67 E	0.75
12600.	0 30	S 87 W	100.	12596.13	126.48 S	8.23 E	0.50
12700.	0 30	N 59 E	100.	12696.13	125.87 S	8.05 E	0.97
12800.	4 0	N 5 E	100.	12796.03	122.66 S	10.05 E	3.73
12900.	5 0	N 3 E	100.	12895.72	114.83 S	10.60 E	1.01
13000.	5 0	N 2 E	100.	12995.34	106.13 S	10.98 E	0.09
13100.	4 45	N 4 E	100.	13094.98	97.64 S	11.42 E	0.30
13200.	5 0	N 10 E	100.	13194.62	89.21 S	12.46 E	0.57
13300.	4 45	N 3 E	100.	13294.26	80.77 S	13.42 E	0.64
13400.	4 30	N 9 E	100.	13393.93	72.76 S	14.26 E	0.54
13500.	4 15	N 0 E	100.	13493.64	65.16 S	14.86 E	0.73
13530.	4 15	N 0 E	30.	13523.56	62.94 S	14.86 E	0.00

FINAL CLOSURE - DIRECTION:
DISTANCE:

S 13 DEGS 17 MINS 5 SECS E
64.67 FEET

DOW CHEMICAL CO.
L.R. SWEETZ WELL NO. 1
PARC PERDUE FIELD

EASTMAN WHIPSTOCK, INC.

HORIZONTAL PROJECTION

SCALE 1 IN. = 20 FEET
DEPTH INDICATOR: MD

FIGURE C-1
C-8

APPENDIX D
PALEONTOLOGICAL REPORT

RECEIVED
DOW-DOE GEOTHERMAL PROJECT

DATE 5/22/81

GEORGE N. MAY & ASSOCIATES

Consulting Geologists and Paleontologists

408 HEYMANN BLVD.

P. O. BOX 51958

LAFAYETTE, LOUISIANA 70505

WILLIAM S. GRUBB

(210) 224-2379

May 21, 1981

Dr. J. S. Wilson
Dow Chemical U.S.A.
Parcperdue Project
P. O. Box 53073
Lafayette, Louisiana 70505

Dear Sir:

I am enclosing herewith a paleo report on the Dow Chemical--
D.O.E., Lee Roy Sweezy # 1, Parcperdue Field, Vermilion Parish,
Louisiana.

If you need additional information, let me know.

Yours very truly,

George N. May

/dmh

Enclosure

GEORGE N. MAY & ASSOCIATES

Consulting Geologists and Paleontologists

408 HEYMANN BLVD.

P. O. BOX 51858

LAFAYETTE, LOUISIANA 70505

WILLIAM B. GRUBB

(318) 234-2379

PALEONTOLOGICAL REPORT

DOW CHEMICAL CO.--D.O.E.

LEE ROY SWEET # 1

SECTION 26-T11S-R4E

PARCERDUE FIELD

VERMILION PARISH, LA.

May 21, 1981

S U M M A R Y

SAMPLE RANGE 11500'	-----	13600'
IN SIPHONINA DAVISI	-----	11500'
CRISTELLARIA 47	-----	11900'
NODOSARIA VERTEBRALIS	-----	12170'
DISCORBIS GRAVELLI	-----	12780'
HET SP. (VERY RARE)	-----	12880'
CIBICIDES JEFFERSONENSIS	-----	13140'
BOLIVINA PERCA	-----	13490'

NO FURTHER DIAGNOSTIC FOSSILS WERE ENCOUNTERED.

Respectfully submitted

George N. May
George N. May

Samples worked by
George May & Bill Grubb

PALEOECOLOGICAL REPORT

DOW CHEMICAL CO. D.O.E.

LEE ROY SWEET # 1

SECTION 26-T11S-R4E

PARCERDUE FIELD

VERMILION PARISH, LA.

May 21, 1981

S U M M A R Y

SAMPLE RANGE 11500'.....13600'
ZONE 2 WEAK.....11500'
ZONE 1-2.....11620'
ZONE 2-3.....11840'
ZONE 2 WITH STREAK OF 2-3 VERY WEAK.....12080'
ZONE 3.....12750'
UNZONED 13,340' DUE TO CONVENTIONAL CORING
(NO SAMPLES).
ZONE 313450'

DEPOSITIONAL RATE

SAMPLE RANGE 11500'.....13600'
D.R. 2.....11500'
D.R. 3.....12520'
D.R. 4.....12560'
D.R. 5.....12750'
D.R. 4.....12810'
D.R. 5.....13020'
D.R. 6.....13170'
UNZONES 13,340'-13,450'
D.R. 5.....13450'

Lee Roy Sweezy #1

11500-30	W.R.	Fine to medium quartz sand, shell fragments, siderite, pyrite, rare very fine sandstone and siltstone Robulus chambersi N. T., v.r.; sp. v.r. Trochammina sp. S., r. (1) Siphonina davisii V.S. Nonion sp. v. r. Textularia sp. S., r. (1) Elphidium rolshauseni S. (1) Amphistegina sp. tiny
11530-60 Ctgs.	W.R.	Similar; very fine-fine quartz sand (1) Siphonina davisii V.S. Nonion sp. r. (1) Discorbis "B"; (1) nomada (1) Globigerina sp. (1) Cibicides concentricus
11560-90 Ctgs.	W.R.	Similar Robulus chambersi v.r. Rotalia sp. f.n. (1) Siphonina davisii Trochammina sp. f.n.
11590-620	W.R.	Similar, increasing grey shale; very noticeable shell fragments (1) Eponides sp. Textularia sp. f. n. (1) Discorbis "B" Trochammina sp. n.
11620-50 Ctgs.	W.R.	Similar; rare shale, rare forams Cristellaria sp. S., v.r. (1) Siphonina davisii
11650-80 Ctgs.	W.R.	Mostly very fine quartz sand, siderite and pyrite
11680-710 Ctgs.	W.R.	Similar
11710-40 Ctgs.	W.R.	Similar
11740-70 Ctgs.	W.R.	Similar (1) Planulina sp. (probably reworked)
11770-800 Ctgs.	W.R.	Similar, rare forams
11800-10 Ctgs.	W.R.	Similar Siphonina davisii v. r.
11810-40 Ctgs.	W.R.	Grey-brown shale and fine loose quartz sand (1) Eponides sp. Nonion sp. v.r. (1) Textularia sp. (1) Discorbis nomada
11840-70 Ctgs.	W.R.	Similar (1) Cristellaria 47 M. (large beads) (1) Cristellaria cf. 47 F.S. Liebusella sp. f. n. Siphonina davisii v.r. Miliolids r. Textularia sp. r. Discorbis "B" v.r. Nonion sp. n.

Lee Roy Sweezy #1

11870-900 Ctgs.	W.R.	Similar, common very fine quartz sand (1) <i>Cristellaria</i> cf. 47 F.S. <i>Liebusella</i> sp. n. <i>Discorbis</i> "B" f.n. <i>Eponides</i> sp. r. (1) <i>Planulina</i> "A"
11900-30	W.R.	Similar, increasing fine-very fine calcareous sandstone <i>Cristellaria</i> 47 F.L.-L., f.n. <i>Eponides</i> sp. v.r. <i>Robulus chambersi</i> v.r. <i>Liebusella</i> sp. f.c.
11930-60 Ctgs.	W.R.	Similar with medium to coarse quartz sand <i>Cristellaria</i> 47 v.r.
11990-020 Ctgs.	W.R.	Similar; fewer forams, less sandstone (1) <i>Cristellaria</i> 47 S. <i>Liebusella</i> sp. f.n.
12020-50 Ctgs.	W.R.	Similar <i>Cristellaria</i> 47 v.r.
12080-110	W.R.	Similar, increasing very fine "tite" sandstone and silt- stone aggregates. (1) <i>Cristellaria</i> 47 (1) <i>Cytheridea collei</i>
12110-40 Ctgs.	W.R.	Similar, noticeable loose very fine sandstone and quartz <i>Robulus chambersi</i> v.r. <i>Discorbis</i> "B" r.
12140-70 Ctgs.	W.R.	Similar; fewer forams (1) <i>Bathysiphon</i> sp.
12170-200 Ctgs.	W.R.	Similar <i>Cristellaria</i> 47 M.-S., v.n. <i>Reophas</i> sp. r. <i>Lenticulina jeffersonensis</i> f.n. <i>Bathysiphon</i> sp. r. <i>Robulus chambersi</i> n. <i>Eponides</i> sp. r. (2) <i>Nodosaria vertebralis</i> fragments <i>Uvigerina</i> sp. S., r.
12200-30 Ctgs.	W.R.	Similar (1) <i>Nodosaria vertebralis</i> fragment <i>Uvigerina howei</i> type S., r.
12230-60 Ctgs.	W.R.	Similar <i>Nodosaria vertebralis</i> v.r. <i>Cristellaria</i> 47 S.-M.-F. L., v.n.
12260-90 Ctgs.	W.R.	Similar <i>Bathysiphon</i> sp. f. n.
12290-320 Ctgs.	W.R.	Similar <i>Cristellaria</i> 47 f.c. <i>Liebusella</i> sp. r. <i>Nodosaria vertebralis</i> fragments r. <i>Uvigerina howei</i> r.
12320-40 Ctgs.	W.R.	Similar

Lee Roy Sweezy #1

12340-80 Ctgs.	W.R.	Similar, increasing very fine sandstone, siltstone and loose quartz <i>Cristellaria</i> 47 v.n. <i>Robulus chambersi</i> f.c. <i>Nodosaria vertebralis</i> fragments v.r. <i>Reophax</i> sp. v.r.
12380-410 Ctgs.	W.R.	Similar, noticeable very fine sandstone and loose very fine quartz sand and silt; fewer forams <i>Nodosaria vertebralis</i> fragments r.
12410-50 Ctgs.	W.R.	Similar
12450-60 Ctgs.	W.R.	Grey shale, very fine quartz sand, rare very fine sand stone; some siltstone and lignite mud additive (1) <i>Robulus chambersi</i> S. (1) <i>Cristellaria</i> fragment S.
12460-70 Ctgs.	W.R.	Similar with increasing siltstone and very fine sandstone aggregates; rare shell fragments <i>Cristellaria</i> sp. v.r. <i>Leibusella</i> sp. v.r. (1) <i>Nodosaria vertebralis</i> S. fragment (1) <i>Guttulina irregularis</i> <i>Uvigerina</i> sp. S., r.
12470-80 Ctgs.	W.R.	Similar <i>Robulus chambersi</i> f.n. <i>Discorbis</i> "B" v.r. <i>Nonion</i> sp. v.r. <i>Miliolids</i> v.r. <i>Glodigerinids</i> v.r.
12480-90 Ctgs.	W.R.	Mostly grey shale, silt and lignite <i>Robulus chambersi</i> r. <i>Uvigerina</i> sp. r.
12490-500 Ctgs.	W.R.	Similar <i>Lenticulina jeffersonensis</i> f.n. (1) <i>Liebusella</i> sp. <i>Robulus chambersi</i> f.n.
12500-10 Ctgs.	W.R.	Similar <i>Lenticulina jeffersonensis</i> f.n. <i>Eponides</i> sp. f.n. <i>Cytheridea isrealnyi</i> v.r. <i>Siphonia</i> sp. v.r. <i>Nonion</i> sp. f. n.
12510-20 Ctgs.	W.R.	Similar; fewer forams
12520-30 Ctgs.	W.R.	Similar <i>Cristellaria</i> 47 r. <i>Eponides</i> sp. r. <i>Uvigerina</i> sp. S., v.r. <i>Reophax</i> sp. v.r. <i>Globigerinids</i> r.
12530-40 Ctgs.	W.R.	Similar

Lee Roy Sweezy #1

12540-50 Ctgs.	W.R.	Similar Nodosaria vertebralis v.r. Liebusella sp. v.r. Robulus chambersi n. Eponides sp. f.n. Cibicides moreyi v.r.
12550-60 Ctgs.	W.R.	Grey shale, siltstone, noticeable very fine quartz sand, lignite mud additive Robulus chambersi F.S., n; sp. r. Cristellaria 47 r. Nonion sp. n. (1) Cibicides concentricus
12560-70 Ctgs.	W.R.	Similar Cristellaria 47 f.n. Eponides sp. n. Robulus chambersi v.n. Globigerinids f.n.
12582 Ctgs. B.U.	W.R.	Similar, slight increase in siltstone and very fine sand- stone fragments Discorbis "B" S., r.
12582-90 Ctgs.	W.R.	Similar
12590-600 Ctgs.	W.R.	Similar Globigerinids n. Milliolids r. Amphistegina sp. v.r.
12600-10 Ctgs.	W.R.	Similar, increasing fine quartz sand aggregates, glauconite fairly noticeable Cristellaria 47 f. c. Liebusella sp. v. r. Robulus chambersi c. Eponides sp. n. Uvigerina cf. howei S., r. Globigerinids f. c. Cibicides moreyi r. Vulvulina ignava v.r. Nonion sp. n.
12610-20 Ctgs.	W.R.	Similar, soft grey shale flakes; increasing very fine quartz sand; rare glauconite and echinoid fragments
12620-30 Ctgs.	W.R.	Grey shale and siltstone, increasing pyrite; fewer, smaller forams
12630-40 Ctgs.	W.R.	Similar Lenticulina jeffersonensis n. Siphonina sp. f. n. Discorbis nomada n. Globigerinids n. Robulus sp. S., n.
12640-50 Ctgs.	W.R.	Similar Discorbis "B" r. Liebusella sp. S., r.
12650-60 Ctgs.	W.R.	Similar with some very fine quartz sand aggregates (1) Ellipsonodosaria sp. Eponides sp. n. Cibicides moreyi f. n. Nonion sp. f. c.

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12660-70 Ctgs.	W.R.	Similar (1) Gyroidina vicksburgensis Uvigerina howei S., r.
12670-80 Ctgs.	W.R.	Similar, increasing light grey shale, glauconite and fine very fine quartz sand; less siltstone
12680-90 Ctgs.	W.R.	Similar Uvigerina howei r. (1) Nodosaria vertebralis fragment Reophax sp. v. r.
12690-700 Ctgs.	W.R.	Similar; fewer forams
12720-50 Ctgs.	W.R.	Abundant cement; noticeable fine-medium quartz sand and grey shale; no forams noted
12750-80 Ctgs.	W.R.	Similar, increasing very fine sandstone Cristellaria 47 c. Robulus chambersi c. (2) Discorbis cf. gravelli (1) Spiroloculina sp. Uvigerina howei c. Globigerinids c. Siphonina sp. thick n.
12780-810 Ctgs.	W.R.	Similar, very noticeable glauconite; abundant forams Discorbis gravelli c. Liebusella sp. n. Cristellaria 47 v.c. Nodosaria Vertebralis r. Uvigerina howei v.c. Gyroidina hannai r.
12810-20 Ctgs.	W.R.	Similar, increasing very fine sandstone, siltstone and fine quartz sand Discorbis gravelli c. Textularia mornhinvegi
12820-50 Ctgs.	W.R.	Predominantly grey-brown shale; noticeable very fine quartz sand and rare glauconite Discorbis gravelli f.n. Lenticulina jeffersonensis r. Robulus chambersi c. Uvigerina howei c.
12850-80 Ctgs.	W.R.	Similar
12880-900 Ctgs.	W.R.	Similar; faunal increase Discorbis gravelli c. Amphistegina sp. f. n. Sorites sp. r. Cristellaria 47 v.n. (2) Miogypsina sp. S. Robulus chambersi v.c. (1) Het sp. S. (fragment) Uvigerina howei v.c. Cibicides moreyi r.
12900-30	W.R.	Similar, increasing fine hard sandstone fragments Miogypsina sp. S., v.r. Textularia mornhinvegi r. Sorites sp. v.r. Spiroloculina sp. r. Liebusella sp. S., r. Gyroidina hannai several

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12930-60 Ctgs.	W.R.	Similar with very noticeable fine to coarse quartz sand and cement fragments (1) Het sp. V.S. (juvenile)
12960-90 Ctgs.	W.R.	Similar, increasing grey shale
12990-020 Ctgs.	W.R.	Similar
13020-50 Ctgs.	W.R.	Similar (1) Het sp. Liebusella sp. f. c. Globigerinids f. c. Nodosaria vertebralis v. r.
13050-70 Ctgs.	W.R.	Similar (1) Uvigerina isreaelskyi; howei r. Liebusella sp. n.
13070-100 Ctgs.	W.R.	Similar with common fine to medium quartz sand, hard silt-stone aggregates, siderite fragments, shell fragments and cement Uvigerina howei c.
13100-10 Ctgs.	W.R.	Coarse extraneous quartz sand, mud additives, forams noticeable Uvigerina howei c. Liebusella sp. r. Cristellaria 47 v.r. Eponides sp. r.
13110-20 Ctgs.	W.R.	Similar Sorites sp. v. r. Discorbis gravelli v.r.
13120-30 Ctgs.	W.R.	Similar Cibicides moreyi v. r.
13130-40 Ctgs.	W.R.	Similar Sorites sp. r.
13140-50 Ctgs.	W.R.	Similar (1) Cibicides jeffersonensis Sorites sp. r.
13150-60 Ctgs.	W.R.	Similar Cibicides jeffersonensis (larger) c. Globigerinids v. c. Discorbis gravelli c. Uvigerina howei v. c. Liebusella sp. f. c. Textularia mornhinvegi
13160-70 Ctgs.	W.R.	Similar Cibicides jeffersonensis c.
13170-80 Ctgs.	W.R.	Similar, very abundant forams (95% forams) Cibicides jeffersonensis a. Globigerinids flood Discorbis gravelli a. Liebusella sp. c. Uvigerina howei v. a. Cristellaria 47 c.

13180-90 Ctgs.	W.R.	Similar
13190-200 Ctgs.	W.R.	Similar, similar forams common
13200-10 Ctgs.	W.R.	Similar with common fine pyrite fragments, pyritized siltstone and very fine quartz sand Globigerinids a. Liebusella sp. n.
13210-20 Ctgs.	W.R.	Similar Liebusella sp. F. S., f.c. Cibicides jeffersonensis v.c.
13220-30 Ctgs.	W.R.	Mostly grey shale, forams, very fine quartz sand; some siltstone, pyrite and glauconite; similar forams less noticeable
13230-40 Ctgs.	W.R.	Similar, abundant forams Cibicides jeffersonensis a. Globigerinids a. Uvigerina howei a.
13240-50 Ctgs.	W.R.	Similar, increasing grey shale fragments, noticeable fine silt aggregates
13250-60 Ctgs.	W.R.	Similar, very abundant forams Globigerinids <u>flood</u> Textularia mornhinvegi v. n. Uvigerina howei <u>flood</u> Vulvulina ignava v. n.
13260-70 Ctgs.	W.R.	Similar Cibicides jeffersonensis v. c.
13270-80 Ctgs.	W.R.	Similar, very noticeable increase in very fine to fine angular to sub-rounded, frosted quartz sand; increasing hard siltstone aggregates; forams less abundant Liebusella sp. n. Globigerinids c.
13280-90 Ctgs.	W.R.	Much less quartz sand; very common forams
13290-300 Ctgs.	W.R.	Similar (1) Bolivina sp. reticulate Nonion cf. chappaotense v.r. Cibicides jeffersonensis c.
13300-10 Ctgs.	W.R.	Similar, increasing very fine to fine loose quartz sand and fine hard silt fragments
13310-20 Ctgs.	W.R.	Similar, abundant forams Cibicides jeffersonensis a.; 10 S., f.n. Liebusella sp. f. c. Globigerinids a. Uvigerina howei a. Sorites sp. v.r.
13320-30 Ctgs.	W.R.	Similar; fewer forams Cibicides 10 S.-M., f. n.; jeffersonensis v.c.

Lee Roy Sweezy #1

13330-40	W.R.	Similar, increasing echinoid fragments, glauconite, pyrite and very fine quartz sand; abundant forams <i>Cristellaria</i> 47 var. v. n. <i>Discorbis gravelli</i> v.n. <i>Nonion</i> cf. <i>chapapotense</i> n.
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Gap in samples from 13340' to 13450'

13450-60 Ctgs.	W.R.	Similar <i>Cibicides jeffersonensis</i> v.n.
13460-70 Ctgs.	W.R.	Similar <i>Globigerinids</i> c. <i>Cibicides jeffersonensis</i> c.
13470-80 Ctgs.	W.R.	Similar
13480-90 Ctgs.	W.R.	Similar
13490-500 Ctgs.	W.R.	Similar <i>Bolivina perca</i> n.
13500-10 Ctgs.	W.R.	Similar <i>Bolivina perca</i> v. n.
13510-20 Ctgs.	W.R.	Similar <i>Bolivina perca</i> c.
13520-30 Ctgs.	W.R.	Very fine sand and silty shale fragments
13530-40 Ctgs.	W.R.	Similar
13540-50 Ctgs.	W.R.	Similar
13550-60 Ctgs.	W.R.	Similar
13560-70 Ctgs.	W.R.	Similar
13570-80 Ctgs.	W.R.	Similar with sideritic silt <i>Bolivina perca</i> c.
13580-90 Ctgs.	W.R.	Similar <i>Bolivina perca</i> v.c.
13590-600 Ctgs.	W.R.	Similar with limestone fragments <i>Bolivina perca</i> c.

APPENDIX E

DESCRIPTION OF CORES

DOW-D.O.E. L.R. SWEEZY NO. 1

TERRA TEK, INC.

DOW Chemical Well Sweezy #1 Core #1
Core Description
Core #1 13340-13340 57.9 recovery

April 9, 1981
Terra Tek, Inc.
Described by:
Mike Holland

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- 13340-13341: Shale: Dark gray-dark green, massive, occasional very fine grain clear quartz grains in matrix, scattered dark mafics.
- 13341-13342: Sandstone: Light gray-gray, fine grain subrounded-well rounded, well sorted, friable, faint bedding at top, becoming massive, clean, clear quartz grains, slightly calcareous, good porosity.
- 13342.6-13342.8: Shale: dark gray stringer, silty, non gradational contact with sand above, gradational with increase in grain size to SS A/A @ 13342.8
- 13342.8-13343: Sandstone: A/A
- 13343-13344: Sandstone: A/A w/some scattered clay-siltstone nodules in sand matrix, white to light gray, -5mm diam.
- 13344-13345: Sandstone: A/A
- 13345-13346: Sandstone: A/A w/apparent horizontal fracture @ 13345.5
- 13346-13347: Sandstone: A/A
- 13347-13348: Sandstone: A/A
- 13348-13349: Sandstone: A/A
- 13349-13350: Sandstone: A/A w/horizontal fracture @ 13349.8
- 13350-13351: Sandstone: A/A fine to medium grain, massive, good porosity, little change lithologically
- 13351-13352: Sandstone: A/A
- 13352-13353: Sandstone: A/A
- 13354-13355: Sandstone: A/A
- 13355-13356: Sandstone: A/A
- 13356-13357: Sandstone: A/A
- 13357-13358: Sandstone: A/A
- 13358-13359: Sandstone: A/A, unconsolidated, well sorted, clear quartz grains, scattered mafics, very clean
- 13359-13360: Sandstone: A/A
- 13360-13361: Sandstone: A/A

(continued)

13361-13362:	Sandstone: A/A, w/horizontal frac. @ 13361.5
13362-13363:	Sandstone: A/A
13363-13364:	Sandstone: A/A
13364-13365:	Sandstone: A/A
13365-13366:	Sandstone: A/A with occasional thin layer of dark silt or mafics, bedding horizontal
13366-13367:	Sandstone: light gray to gray, decreasing grain size fine grain, thin dark gray shale laminations more frequent alternating w/sands, banded appearance
13367-13368:	Sandstone: A/A
13368-13369:	Sandstone: A/A, becoming more silty, darker in color
13369-13370:	Sandstone: A/A, except becoming cleaner, horizontal bedding w/scattered clay-siltstone nodules, occasional thin laminations of dark silt or mafics, well sorted, friable, good porosity.
13370-13371:	Sandstone: A/A
13371-13372:	Sandstone: A/A, massive, unconsolidated
13372-13373:	Sandstone: A/A
13373-13374:	Sandstone: A/A
13374-13375:	Sandstone: A/A
13375-13376:	Sandstone: A/A
13376-13377:	Sandstone: A/A
13377-13378:	Sandstone: A/A, except more consolidated
13378-13379:	Sandstone: A/A
13379-13380:	Sandstone: A/A, w/large burrow @ 1"inch diameter vertically
13380-13381:	Sandstone: A/A, except becoming siltier w/transition to dark gray-green siltstone @ 13380.6
13381-13382:	Siltstone: dark gray-green, occasional silty sand stringer, cross bedded, banded appearance

(continued)

13382-13383: Sandstone: Light gray-gray, fine-very fine grained, horizontal bedding, well consolidated, well sorted, becoming massive, scattered dark mafics, slightly calcareous

13383-13384: Sandstone: A/A

13384-13385: Sandstone: A/A

13385-13386: Sandstone: A/A

13386-13387: Sandstone: A/A

13387-13388: Sandstone: A/A

13388-13389: Sandstone: A/A

13389-13390: Sandstone: A/A

13390-13391: Sandstone: A/A

13391-13392: Sandstone: A/A

13392-13393: Sandstone: A/A

13393-13394: Sandstone: A/A

13394-13395: Sandstone: A/A, becoming siltier, thin silt laminae, banded appearance

13395-13396: Sandstone: A/A, except becoming much cleaner, very fine-fine grained, predominantly massive, occasional shale stringer w/non-gradational contact w/sand.

13396-13397: Sandstone: A/A

13397-13398: Sandstone: A/A

13398-13399: Sandstone: A/A

13399-13400: Sandstone: A/A

13399-13400: Sandstone: A/A - BOTTOM OF CORE #1 -

DOW Chemical Well Sweezy #1
Core Description
Core #2 13,400-13,460 58.8' recovery

April 10, 1981
Terra Tek, Inc.
Described by:
Mike Holland

13400-13401:	Sandstone: Light gray-gray, fine grained, well sorted, sub-round to rounded clear quartz grains, scattered dark mafics, clean, good porosity, abundant vertical laminations.
13401-13402:	Sandstone: A/A, w/crossbedding, burrows, silty laminations, banded appearance, slightly calcareous
13402-13403:	Sandstone: A/A
13403-13404:	Sandstone: A/A
13404-13405:	Sandstone: A/A, w/carbondaceous material scattered in sand matrix, sand flow structures truncating original bedding laminations vertically
13405-13406:	Sandstone: A/A, w/frequent crossbeds, very calcareous streak @ 13405.6, burrowing common, occasional silty laminae
13406-13407:	Sandstone: A/A
13407-13408	Sandstone: A/A
13408-13409:	Sandstone: A/A, w/increasing silty laminae
13409-13410:	Sandstone: A/A
13410-13411:	Sandstone: A/A
13411-13412:	Sandstone: A/A, w/decreasing grain size
13412-13413:	Sandstone: A/A, w/decreasing burrows, dipping becs, USGS Sample 13412-13412.3
13413-13414:	Sandstone: A/A, w/some convoluted silty laminae
13414-13415:	Sandstone: A/A
13415-13416:	Sandstone: A/A, USGS Sample 13415.5-13416.1
13416-13417:	Sandstone: A/A
13417-13418:	Sandstone: A/A, w/sharp contact w/dark gray shale stringer @ 13417.3
13418-13419:	Siltstone: Alternating bands of sand and silty shale, occasional clean sand stringer in otherwise alternating silty sand and silt laminations.

(continued)

13419-13420:	Siltstone: A/A, w/occasional burrow in sand stringers, stringers 1" - 5" thick.
13420-13421:	Siltstone: A/A, USGS Sample 13420.1-13420.6
13421-13422:	Siltstone: A/A, w/cross bedding, individual beds 1-3 cm thick.
13422-13423:	Sandstone: Light-medium gray, fine grained, moderately well sorted, acicular fabric of darker carbonaceous (?) material in sand matrix, possibly glauconite, USGS Sample 13422.7 - 13422-9.
13423-13424:	Sandstone: A/A, last good sand in cored interval
13424-13425:	Shale: Dark gray-green, mod hd, massive in part fissile, some silty streaks, occasional sand stringer in non-gradational contact w/shale.
13425-13426:	Shale: A/A, with sand stringers, banded appearance
13426-13427:	Shale: A/A
13427-13428:	Shale: A/A
13428-13429:	Shale: A/A
13429-13430	Shale: A/A, with occasional light gray lenticular mud class, USGS Sample 13429.6-13430.15
13430-13431:	Shale: A/A
13431-13432:	Shale: A/A
13432-13433:	Shale: A/A
13433-13434:	Shale: A/A
13434-13435:	Shale: A/A
13435-13436:	Shale: A/A
13436-13437:	Shale: A/A, USGS Sample 13436.9-13437.6
13437-13438:	Shale: A/A, w/shale becoming more massive, fewer sand stringers
13438-13439:	Shale: A/A
13439-13440	Shale: A/A
13440-13441:	Shale: A/A

(continued)

13341-13442:	Shale: A/A, w/fewer sand stringers, occasional light gray mud clasts in shale matrix, shale becoming waxy in appearance, massive, sand stirngers appear deformed
13342-13343:	Shale: A/A
13443-13444:	Shale: A/A
13444-13445:	Shale: A/A
13445-13446:	Shale: A/A
13446-13447:	Shale: A/A, USGS Sample 13446.9-13447.5
13447-13448:	Shale: A/A
13448-13449:	Shale: A/A
13449-13450:	Shale: A/A, massive, fiffle, occasional clay clast
13450-13451:	Shale: A/A
13451-13452:	Shale: A/A
13452-13453:	Shale: A/A
13453-13454:	Shale: A/A
13454-13455:	Shale: A/A
13455-13456:	Shale: A/A, USGS Sample 13455.0-13455.8
13456-13457:	Shale: A/A
13457-13458:	Shale: A/A
13458-13459:	Shale: A/A
13459-13460:	Shale: A/A, USGS Sample 13459.6-13460.2

--BOTTOM OF CORE 2--