FOSSIL ENERGY

DOE/BC/14960-19
Vol. 2 of 4
(OSTI ID: 791331)

POST WATERFLOOD CO_2 MISCIBLE FLOOD IN LIGHT OIL FLUVIAL DOMINATED DELTAIC RESERVOIR – PROJECT PERFORMANCE YEARS 1995-1997

Final Report
June 1, 1993-December 31, 1997

By:
Sami-Bou-Mikael

Date Published: February 2002

Work Performed Under Contract No. DE-FC22-93BC14960

Texaco E&P
New Orleans, Louisiana

National Energy Technology Laboratory
National Petroleum Technology Office
U.S. DEPARTMENT OF ENERGY
Tulsa, Oklahoma

DOE/BC/14960-19
Vol. 2 of 4
Distribution Category UC-122

Post Waterflood CO_2 Miscible Flood in Light Oil Fluvial Dominated Deltaic Reservoir
Project Performance Years 1995-1997

By
Sami Bou-Mikael

February 2002

Work Performed Under DE-FC22-93BC14960

Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

Gary Walker, Project Manager
National Petroleum Technology Office
P.O. Box 3628
Tulsa, OK 74101

Prepared by
Texaco E&P
400 Poydrass Street
New Orleans, LA 70130

TABLE OF CONTENTS

FISCAL YEAR
1997

FISCAL YEAR 1997

INTRODUCTION

Production decline stabilized to 60 BOPD from two wells Kuhn #14 and Kuhn #38 in the first quarter of 1996. However Kuhn 38 went off production due to mechanical problems, therefore Kuhn 14 was the only well producing. The project was at a negative cash flow because of the workover failure at Kuhn #38. The CO_2 recycled volume dropped below 2 MMCF, enabling us to maintain only one compressor active. Water injection in the project had been discontinued due to low injectivity and that caused high back pressure at the wells, which eventually caused mechanical problems at the pump. However, CO_2 injection was discontinued in September in preparation for the termination of the project. The remaining oil in the vicinity of this well is minimal according to the reservoir simulation and the well high GOR production history. The project termination point deemed the project uneconomic. The following pages are the quarterly reports and attachments for the fiscal year 1997 and the first quarter of 1998.

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

First Quarter, 1997

Executive Summary

Production decline in the Port Neches project is stabilizing at 60 BOPD from two wells Kuhn #14 and Kuhn #38. The project is quickly approaching the economic limit and should be evaluated for conclusion in the near future. The CO_2 recycled volume is dropping below 2 MMCFD, enabling us to maintain only one compressor active.

First Quarter 1997, Objectives

* Monitor reservoir performance, and continue project operations if economically feasible.

Currently water injection in the project has been discontinued due to low injectivity and that caused high backpressure at the wells, which eventually caused mechanical problems at the pump. However, CO_2 injection is continuing in wells Kuhn #42 and Stark #10. Freezing problems occurred in the December forcing us to shut in all CO_2 operations for nearly two weeks. Well Kuhn 15R has been evaluated for a workover and it was determined that it is mechanically risky due to corrosion of the tubing and casing strings. The remaining oil in the vicinity of this well is minimal according to the reservoir simulation and the well high GOR production history. TEPI will continue to produce the current wells until the decision is made in the next few weeks regarding the project continuation.

Discussion of Results - Field Operations

The following is a list of the most recent well tests taken during the month of December 1996, for the producing and injection wells:

Producers:	Kuhn #14,	35 BOPD,	97 % BS&W,	470 PSI,	34 CK.
	Kuhn #38	34 BOPD,	95 % BS&W,	450 PSI,	10 CK.

Injectors:	Kuhn #42,	1270 MCFD,	1043 PSI,
	Stark #10,	619 MCFD,	1045 PSI.

The Financial Status Report, Management Summary, Milestone Schedule and Federal Transaction Report are included in this report.

Discussion of Results - Technology Transfer

LSU submitted the final report regarding the screening criteria for application of carbon dioxide miscible displacement in waterflood reservoir containing light oil (copy attached). Texaco will be conducting a workshop at Prairie View A& M University Graduate School & Research.

Second Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project economics.

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Jan 1, 1997 - Mar 31, 1997**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTIN ELEMENT	9. DURATION 1993 1Q	2Q	3Q	4Q	1994 1Q	2Q	3Q	4Q	1995 1Q	2Q	3Q	4Q	1996 1Q	2Q	3Q	4Q	CURRENT FISCAL YEAR 1997 1Q	2Q	3Q	4Q	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering				1																	100%	100%
1.2	Extraction Technology				2																	100%	100%
2.1	Recording Daily Production				3															A		50%	50%
2.2	Reservoir Charac-terization				4	B					C											100%	100%
2.3	Site Operation & Field Work		D	E					F													100%	100%
2.4	CO2			6																		50%	50%
2.5	EH&S Monitoring & Compliance		G H	7																		50%	50%
3.1	CO2 Screening Model							J 8														100%	100%
3.2	Environmental Analysis									9												100%	100%
3.3	FDD Database & Model									K				10								100%	100%
3.4	Technical Publications								L										11			50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

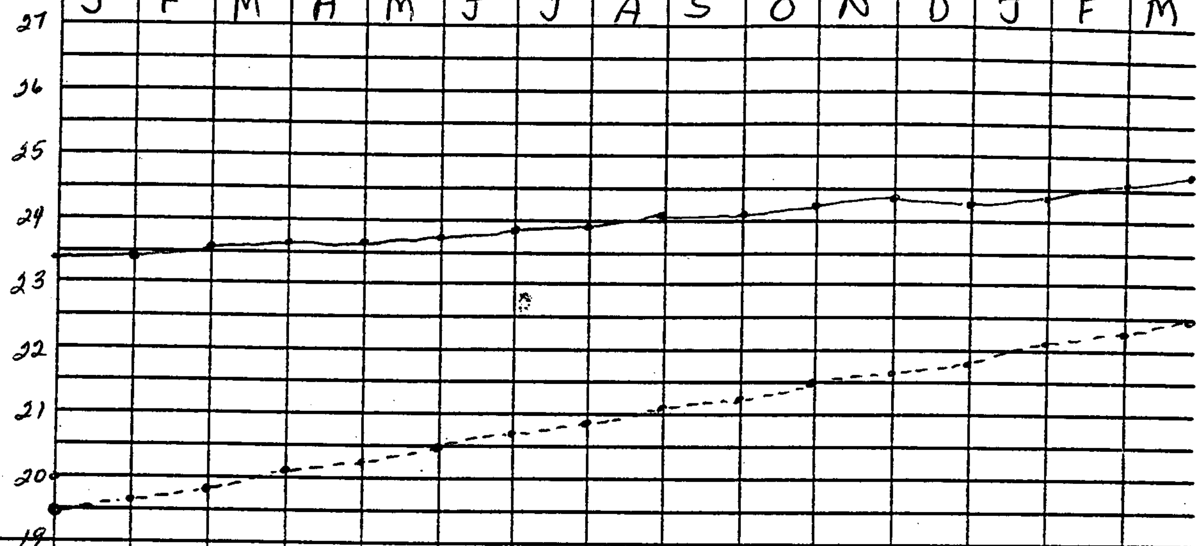
1. IDENTIFICATION NUMBER: DE-FC22-93BC14960
2. PROGRAM/PROJECT TITLE: CLASS I
3. REPORTING PERIOD: 1/1/97 - 3/31/97

4. PARTICIPANT NAME AND ADDRESS:
TEXACO EXPLORATION & PRODUCTION INC
400 POYDRAS ST.
NEW ORLEANS, LA 70130

5. START DATE: 6/1/93
6. COMPLETION DATE: 12/31/97

7. FY
8. MONTHS: J F M A M J J A S O N D J F M

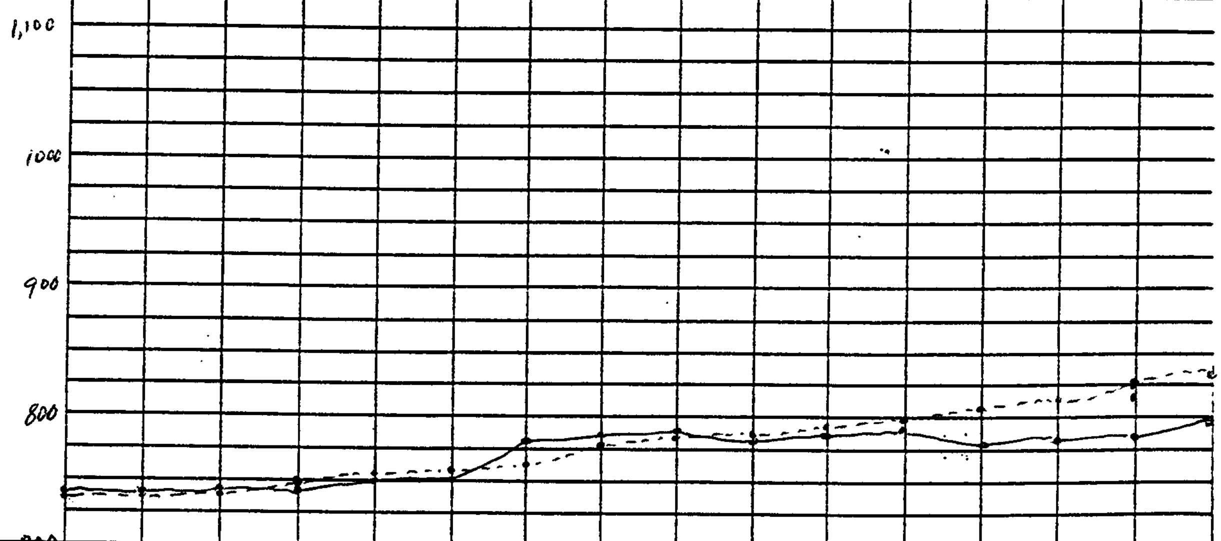
9. COST STATUS
a. $ Expressed in: MILLIONS
b. Budget and Reporting No.: AC1510100
c. Cost Plan Date: 6-23-93
d. Actual Costs Prior Years: 23,464
e. Planned Costs Prior Years: 19,516
f. Total Estimated Cost for Contract: 10,085
g. Total Contract Value: 2,985
h. Estimated Subsequent Reporting Period



Accrued Costs	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
h. Actual	48	51	67	56	61	148	61	46	23	377	26	(34)	17	46	100
i. Variance	162	159	143	154	149	62	149	164	187	<167>	184	244	193	164	110
j. Cumulative Variance	<705>	<546>	<403>	<249>	<100>	<38>	111	275	462	295	479	723	916	1080	1190

10. LABOR STATUS
a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A DIRECT LABOR
c. Planned Labor Prior Fiscal Years: 731
d. Actual Labor Prior Fiscal Years: 734
e. Total Estimated Labor for Contract: 465
f. Total Contract Labor: N/A

LEGEND
Planned: - - - - - -
Actual: ________
Projected: . . . .



Labor	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
h. Actual	0	9	4	5	7	22	4	4	3	2	2	<20>	3	6	21
i. Variance	7	<2>	3	2	0	<15>	3	3	4	5	5	27	4	1	<14>
j. Cumulative Variance	4	2	5	7	7	<8>	<5>	<2>	2	7	12	39	43	44	30

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Jan 1, 1997 - Mar 31, 1997**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

8

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE Sami Bou-Mikael 5/15/97

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted **U. S. Department of Energy**	2. Federal Grant or Other Identifying Number Assigned By Federal Agency **DE-FC22-93BC14960**	OMB Approval No. 0348-0039	Page **1**	of **1 pages**

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number **51-0265713**	5. Recipient Account Number or Identifying Number **323037151**	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual
8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) **January 1, 1995**	To: (Month, Day, Year) **December 31, 1997**	9. Period Covered by this Report From: (Month, Day, Year) **01-01-97**	To: (Month, Day, Year) **03-31-97**

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	**$3,850,455.84**	**$162,499.74**	**$4,012,955.58**
b. Recipient share of outlays (64.39%)	**$2,479,308.52**	**$104,633.58**	**$2,583,942.10**
c. Federal share of outlays (35.61%)	**$1,371,147.32**	**$57,866.16**	**$1,429,013.48**
d. Total unliquidated obligations	**0.00**	**0.00**	**0.00**
e. Recipient share of unliquidated obligations	**0.00**	**0.00**	**0.00**
f. Federal share of unliquidated obligations	**0.00**	**0.00**	**0.00**
g. Total Federal share (Sum of lines c and f)	**$1,371,147.32**	**$57,866.16**	**$1,429,013.48**
h. Total Federal funds authorized for this funding period	**$2,984,599.00**	**$0.00**	**$2,984,599.00**
i. Unobligated balance of Federal funds (Line h minus line g)	**$1,613,451.68**	**($57,866.16)**	**$1,555,585.52**

11. Indirect Expense **(Labor)**	a. Type of Rate (Place "X" in appropriate box) **[X]** Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate **78.62%**	c. Base **$30,152.63**	d. Total Amount **$23,706.00**	e. Federal Share **$8,441.71**

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

Amount shown in Row a. for this period's transactions include an adjustment of $(5,800.85) due to changes in G&A and Indirect Labor charges.

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title **Sami Bou-Mikael - Project Manager**	Telephone (Area code, number and extension) **(504) 593-4565**
Signature of Authorized Certifying Official Sami Bou-Mikael	Date Report Submitted

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION Name: **Texaco Exploration and Production Inc.** Number and Street: **400 Poydras St.** City, State and Zip Code: **New Orleans, Louisiana 70130**	4. Federal grant or other identification number **DE-FC22-93BC14960**	5. Recipient's account number or identifying number [redacted]
	6. Letter of credit number **NA**	7. Last payment voucher number **-**
	Give total number for this period	
	8. Payment Vouchers credited to your account **-**	9. Treasury checks received (whether or not deposited) **0**
	10. PERIOD COVERED BY THIS REPORT	
3. FEDERAL EMPLOYER IDENTIFICATION NO> **51-0265713**	FROM (month,day,year) **01/01/97**	TO (month,day,year) **03/31/97**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	**$0.00**
	b. Letter of credit withdrawals	**$0.00**
	c. Treasury check payments	**$0.00**
	d. Total receipts (Sum of lines b and c)	**$0.00**
	e. Total cash available (Sum of lines a and d)	**$0.00**
	f. Gross disbursements	**$0.00**
	g. Federal share of program income	**$0.00**
	h. Net disbursements (Line f minus line g)	**$0.00**
	i. Adjustments of prior periods	**$0.00**
	j. Cash on hand end of period	**$0.00**
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	**$0.00**
	l. Advances to subgrantees or subcontractors	**$0.00**

14. REMARKS

15. CERTIFICATION		
AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE Sami Bou-Mikael	DATE REPORT SUBMITTED
	TYPED OR PRINTED NAME AND TITLE **Sami Bou-Mikael - Project Manager**	TELEPHONE (Area Code, Number, Extension) **(504) 593-4565**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

Summary

In conjunction with a joint Texaco/DOE research project, the LSU Department of Petroleum Engineering developed an improved method of screening reservoirs for application of a carbon dioxide miscible enhanced oil recovery (EOR) process. This method, which can be applied to a large number of reservoirs, considers both the technical and economic feasibility of the EOR process.

The technical parameters of each reservoir are first compared to those of an "ideal" reservoir; and from that comparison, each reservoir is assigned a technical ranking. The technical ranking is used to estimate expected recovery. Key technical parameters used in the screening process are remaining oil in place, minimum miscibility pressure, reservoir depth, oil API gravity, and formation dip angle.

The reservoirs are subsequently screened for economic feasibility based on standardized capital costs and operation expenses that are representative of the reservoirs under consideration. The reservoirs are finally ranked based on the present worth value of revenues to costs ratio.

Using this method, we screened a database containing 197 light-oil waterflooded reservoirs in Louisiana. The database includes three reservoirs where CO_2 miscible floods are ongoing; these reservoirs ranked first, second and twelve. The high ranking of these reservoirs, which were selected based on detailed and comprehensive reservoir studies, validates the screening method.

Different implementation options in a specific reservoir can be screened if warranted, by using CO_2 - PROPHET, a PC compatible software. CO_2 -PROPHET is a relatively simple numerical model capable of simulating water and gas floods. An example of its application is included.

Introduction

In 1992 Texaco Exploration and Production Inc. (TEPI) and the U. S. Department of Energy (DOE) entered into a cost-sharing cooperative agreement to conduct an Enhanced Oil Recovery (EOR) demonstration at Port Neches field, Orange County, Texas. The agreement was formulated under DOE Class I Oil Program, which encourages the development of innovative technical approaches to enhanced oil recovery. The innovative aspect of this project is the application of CO_2 miscible flooding in waterflooded light-oil fluvial-dominated reservoirs. TEPI agreed to disseminate the lessons and the experience gained at Port Neches to other operators in the petroleum field.

Louisiana State University (LSU) has agreed to assist TEPI with technology transfer efforts. LSU's role was mainly to identify and rank waterflooded Louisiana reservoirs where the CO_2 EOR process is applicable. To achieve this goal, LSU needed to develop a screening process that could be applied to reservoirs listed in the Louisiana Office of Conservation database. To be meaningful to interested operators, the screening method had to consider both the technical and economic feasibility of the EOR process. Because economic feasibility depends highly on CO_2 availability, identifying CO_2 sources and their distance to prospective reservoirs was imperative.

Once a prospect is identified, management options need to be considered. This task requires a user friendly numerical simulator. The effect of reservoir heterogeneity and well locations which is not considered in the initial screening can be investigated when performing the numerical simulations.

Review of Past Field Applications

The oil industry has extensive experience in carbon dioxide miscible displacement for enhanced oil recovery.[1-7] Fundamentals of the behavior of oil in presence of carbon dioxide, its characteristics and potential have been discussed by several authors.[8-16] In the case considered in this study, that is, miscible displacement, relatively reliable correlations have been developed to determine the minimum miscibility pressure.[17-21] Accumulated knowledge ranges from successful field applications almost at the end of their application, to many projects currently under development.[22-44] Following are the synopses of the published field experiences in waterflooded sandstone reservoirs.

Recovery results are encouraging, even though it is difficult to quantify the final outcome because many projects are still in progress. The CO_2 process is applicable in waterflooded and primary depleted reservoirs regardless of the original oil-in-place (OOIP). However, the remaining oil saturation must be high enough to justify the cost of miscible displacement.

Recovery efficiencies ranged from 2 to 19% of OOIP, and the net amount of CO_2 required to recover an incremental barrel of oil varied from 3 to 13 thousand cubic feet (Mscf). The average recovery for documented cases is 10.8% of OOIP and the average utilization ratio is 7.2 Mscf of CO_2 per incremental barrel of oil. Data is scarce on CO_2 cost and estimates vary between 0.50 to 2.0 \$/Mstb.

The most common spacing used was 40 acres per well, even though some applications, especially pilot tests, had spacings of 10 acres. The preferred configuration was the 5-spot pattern, sometimes combined with line drive patterns. The predominant injection mechanism was a 1:1 water alternating gas (WAG), with innovations such as hybrid injection and tapered injection. Injected carbon dioxide volumes varied between 19 and 60% of the hydrocarbon pore volume (HCPV) with an average of 36% HCPV. Reported reservoir dips varied between 4° and 30°, with a clear preference for reservoirs with a low dip angle. Several of the reservoirs had an initial gas cap.

The most common problems were corrosion which was reported in 58% of the cases reviewed, followed by low vertical sweep efficiency in 50% of the cases. Asphaltene or paraffin precipitation occurred in 30% of the cases. It was also evident that the industry has gained a lot of experience dealing with these problems and have found ways to prevent or minimize them.

Project economics were not always reported, but at least half of the documented cases were profitable. Carbon dioxide accounted for a large fraction of the project cost. Most of the reported sources of carbon dioxide were nearby industrial plants which allowed easy transport and processing of the CO_2. Using the average estimated CO_2 utilization and an assumed cost of $0.60/ Mscf of CO_2, the average cost per incremental barrel of oil is about $4.5.

During many of these projects, the process was modified to maximize recovery efficiency. It was necessary to have efficient monitoring and maintenance programs so that the process performance could be assessed as the project proceeded. It is apparent that additional research is needed in order to improve vertical sweep efficiency. It is necessary to improve reservoir characterization and correctly assess the problems of continuity and channeling.

Many field operations can be improved to reduce cost and enhance economics. These operations include optimized use of existing wells, improvements in sweep efficiency by using gels or polymers or selective injection, reutilization of existing facilities, optimization of the reservoir fill-up, CO_2 recycling; and the use of horizontal drilling technology. Use of sophisticated technology such as 4-D seismic, compositional simulation and geostatistics techniques could be economically feasible in certain large reservoirs.

Review of Screening Methods

Screening is usually performed following certain guidelines and criteria developed from laboratory tests and field experience. Screening methods include reservoir performance prediction, binary comparison and, parametric optimization. Klins[13] assembled a chronological list of available screening guides for the carbon dioxide miscible process.

As experience with carbon dioxide processes increases, the results of field applications are used to define ranges of operating and reservoir parameters needed for successful application of a given process. Binary screening methods have been frequently used as preliminary screening tools because they are easy to use.

Rivas *et. al.*[46] presented a screening method based on parametric optimization. Reservoir parameters examined were: temperature, pressure, porosity, permeability, dip, API gravity, oil saturation, net oil sand thickness, minimum miscibility pressure, saturation pressure, remaining oil-in-place, and reservoir depth. An arbitrary heuristic function, called the exponentially varying function, was used to rank the set of reservoirs. The function's value depends exponentially on the weighted differences between the properties characteristic of each reservoir and a set of optimum parameters obtained for an "ideal" reservoir using numerical simulation.

Recently, Chung *et. al*[48]., presented a novel approach to asses an EOR project performance which is based on the application of artificial intelligence in the form of a fuzzy expert system. The method incorporates experts' experience to screen EOR methods, estimate field performance and perform economic analysis. The method determines overall recovery efficiency as result of the fuzzy set arithmetic product of estimates of displacement efficiency and vertical sweep efficiency, which are treated as fuzzy variables. Economic analysis considers recovery efficiency, residual oil in place, oil price and operating costs.[48]

Some screening methods use estimated incremental oil recovery, CO_2 breakthrough, and project economics to estimate a value of after-tax profit. Normally this profit is expressed in terms of discounted cash flow (DCF) and rate of return (ROR).[13]

Several numerical simulators can predict the process performance. DOE CO_2 predictive model[52,54] and DOE CO_2 Prophet[53,54] are not suited to screen a large number of possible candidates because of the time required. Carbon Dioxide Predictive Model (CO_2PM) basically consists of a one - dimensional fractional flow model, which includes modifications to account for the effects of viscous fingering, reservoir heterogeneities, and gravity segregation. Areal sweep calculations generate production rates for oil, water, and CO_2.[55] The most restrictive characteristics of CO_2PM are the fixed five spot well configuration, the inability to simulate alternate injection schemes such as hybrid and tapered WAG, and the optimistic predictions of oil rate and recovery.[55]

PC Prophet[56], a water and gas flood prediction software was developed by Texaco with support of the U.S. Department of Energy (DOE), has been shown to be a good tool for screening, reservoir management and economic analysis. It is available to the industry with a detailed user manual. Ease of use and PC compatibility were emphasized in its development. It computes streamlines between injection and production wells to form streamtubes, making flow computations along them. It considers miscible flow and vertical heterogeneity.

Screening for Technical Feasibility

Reservoir performance prediction methods were excluded because of the relatively large number of reservoirs to be screened. Binary screening methods were also excluded because they do not account for the synergistic effects of reservoir parameters. For example, with the binary comparison method, a reservoir that has properties marginally within the recommended ranges would be selected over a reservoir that has very good values of all properties except one.

We opted for the parametric optimization method developed by Rivas *et al.*[46] Their screening method is based on determining for each property (j) of the reservoir (i) being ranked a corresponding normalized parameter $x_{i,j}$, defined by:

$$X_{i,j} = \frac{|P_{i,j}-P_{o,j}|}{|P_{w,j}-P_{o,j}|} \tag{1}$$

where $P_{o,j}$ is the magnitude of the property (j) in a fictitious reservoir called the optimum reservoir, which gives the best response ot CO_2 flooding. $P_{w,j}$, on the other hand, is the value of the property (j) in another ficitious reservoir, called the worst reservoir, which is not suited to CO_2 flooding. The variable $x_{i,j}$ varies linearly between 0 and 1.

Because an exponential function is more adequate than a linear function for comparing different elements within a set, the normalized linear parameter $x_{i,j}$, is transformed to exponential varying parameter $A_{i,j}$ using the following heuristic equation:[46]

$$A_{i,j} = 100e^{-4.6x_{i,j}^2} \tag{2}$$

$A_{i,j}$ range from a minimum of 1 to a maximum of 100. To take into account the relative importance, or weight, of each reservoir parameter, a weighted grading matrix $w_{i,j}$, is determined as follows:

$$w_{i,j} = A_{i,j} w_j \tag{3}$$

where w_j is the weight of property (j).

The reservoirs are then ranked using a ranking parameter, R_i, defined as:

$$R_i = 100 * \frac{\sum_{j=1}^{j} M_{i,j}}{\sum_{j=1}^{j} M_{1,j}} \tag{4}$$

where $M_{i,j}$ is the product of the weighted matrix $w_{i,j}$ by its transpose, $w_{j,i}$.

The parameters used in the parametric optimization screening are oil API gravity, reservoir temperature, saturation of oil before process application, porosity, permeability, ratio of reservoir pressure to CO_2 minimum miscibility pressure (MMP), net pay oil thickness, and reservoir dip. Other important parameters such as oil viscosity, gas to oil ratio, and bubble point pressure were excluded for simplicity purposes. These properties, however, correlate with oil gravity which is included in the screening.

The properties of the optimum reservoir $p_{o,j}$, used in equation 1 were obtained by performing numerical simulation on a base case to determine the set of parameters that optimized reservoir response to CO_2 flooding[46]. The relative importance or weight of each parameter on process performance was determined from the average normalized slopes of the reservoir performance around the optimum value of the parameter.[47] Optimum reservoir parameters and weighting factors are given in Table 1.

The properties of the worst reservoir $p_{w,j}$ are determined using the data of the reservoirs to be ranked. The value farthest away from the optimum is the worst value. It is conceivable to have two worst values, one lower and one higher than the optimum. Worst parameters of the reservoirs considered in this study are listed in Table 2.

TABLE 1: Optimum Reservoir Parameters and Weighting Factors.[46]

Parameter	Optimum	Weight
API Gravity	37	0.24
Oil saturation, %	60	0.20
Pressure/MMP	1.30	0.19
Temperature, °F	160	0.14
Net oil thickness, ft.	50	0.11
Permeability, md	300	0.07
DIP, °	20	0.03
Porosity, %	20	0.02

TABLE 2: Worst Parameters from Louisiana's Reservoir Database.

Parameter	Lower Limit	Upper Limit
API Gravity	24	48
Oil saturation, %	8	80
Pressure/MMP	0.10	1.47
Temperature, °F	80	276
Net oil thickness, ft	5	175
Permeability, md	17	3485
Dip, °	0.03	64
Porosity, %	17.6	34

CO_2 Sources and Providers in Louisiana

Critical to the economic feasibility of the process is the availability and location of CO_2 sources. A list of CO_2 industrial sources and providers was compiled through personal interviews and by reviewing a brochure published by the Louisiana Chemical Association.[57] Some potential commercial sources/ providers of CO_2 were also identified from a computer database compiled by Louisiana State University.[58] A complete list of CO_2 providers in Louisiana is given in Appendix A.

Naturally occurring CO_2 reservoirs are associated with the Jackson Dome geologic structure in Mississippi. Shell operates a pipeline that runs from Jackson Dome to Week's Island field. The pipeline has two sections: a 20 inch and a 10 inch. The 20-inch pipeline crosses from Mississippi into Louisiana in St. Helena Parish and continues across St. Helena, Livingston, East Baton Rouge, Ascension, and Iberville parishes. A site just northeast of Pierre Part serves as a pumping station where the 20-inch and 10-inch pipelines connect. The 10-inch pipeline, crosses Assumption, St. Martin, St. Mary, and Iberia parishes, and terminates at Week's Island field. The last 16 miles of this pipeline were leased and are temporarily being used for hydrocarbon transportation. The remaining northern portion is still used to transport a small amount of CO_2 to Shell projects. The pipeline is available for tap-ins. Figure 1 shows fields with at least one waterflooded reservoir, plant sources of CO_2, and the location of the Shell pipeline. Fields with at least one waterflooded reservoir are also listed alphabetically in Table 3.

History of CO_2 Use in Enhanced Oil Recovery Efforts in Louisiana

The Department of Natural Resources (DNR) provided information on 23 CO_2 recovery projects within Louisiana. Of these 23, Texaco has 11 in five fields, Shell has three in two fields, ARCO has two (both sold to TXO) in one field, Chevron has six (two sold to Greenhill Petroleum) in three

TABLE 3: Fields with at Least One Waterflooded Reservoir

Avery Island
Bancroft
Bay Marchand
Bay St. Elaine
Bayou Choctaw
Bayou des Glaise
Bayou Fordoche
Bayou Middle Fork
Bayou Sale
Belle Isle
Bellevue
Big Creek
Black Bayou
Bossier
Buckhorn
Bull Bayou
Bully Camp
Burrwood
Caddo (Jeems Bayou)
Caddo-Pine Island
Caillou Island
Carterville
Catahoula Lake
Cecelis
Chemard Lake
Clovelly
Cotton Valley
Cut Off
Dave Haas
Delhi
Delta Farms
Delta Duck Club
Deltabridge
DeSoto - Red River
DeSoto - Red River (Bull Bayou)
Dog Lake
Duck Lake
Dykesville
East Hackberry
East Larto Lake
East Longville
Erath
Eugene Island Block 18
Eugene Island Block 19
Frisco
Garden City
Garden Island Bay
Good Hope
Grand Bay
Grand Isle Block 18
Grand Lake
Greenwood-Waskom
Grogan
Haynesville
Hester
Holly
Hurricane Creek
Iota
Iowa
Jefferson Davis
Jennings
Killens Ferry
Klondike
Lafitte
Lake Barre
Lake Enfermer
Lake Hatch
Lake Hermitage
Lake Mongulois
Lake Peltto
Lake Salvador
Lake Washington
Larose
Larto Lake
Leeville
Lisbon
Little Lake
Little Temple
Livingston
Livonia
Lockhart Crossing
Locust Ridge
Longville
Main Pass Block 35
Main Pass Block 41
Main Pass Block 69
Mamou
Manila Village
Mira
Naberton (Bull Bayou)
Napoleonville
Nebo-Hemphill
Newlight
North Burtville
North Cankton
North Missionary Lake
North Shongaloo-Red Rock
Northeast Lisbon
Olla
Opelousas
Opelousas
Ora
Panther Creek
Paradis
Patterson
Perry Point
Pine Island
Pleasant Hill
Plumb Bob
Port Barre
Potash
Quarantine Bay
Red River-Bull Bayou
Redland
Rodessa
S.E. Manila Village
Saline Lake
Section 28
Sentell Field
Shongaloo
Shongaloo-Pettet, W Seg
Siegen
Simpson Lake
South Bayou Mallet
South Black Bayou
South Pass Block 24
South Pass Block 27
Southeast Pass
Southeast Pass & S. Pass Blk. 6
Southwest Lisbon
Starks
Sulphur Mines
Ten Mile Bayou
Tepetate
Timbalier Bay
Valentine
Vatican
Venice
Ville Platte
West Bay
West Cote Blanche Bay
West Delta Block 83
West Delta Block 84
West Hackberry
West Lake Verret
West Lisbon
West Tepetate
West White Lake
White Castle

fields, all but one are in south Louisiana and Hunt has one in Olla field in LaSalle Parish. Not all of these projects are presently active. A list of the projects along with company ownerships and permit application dates is given in Table 4.

C.F. Industries (now operating as Cherokee Associates) of Baton Rouge, Louisiana, has provided and transported CO_2 in liquid form to eight of the 23 projects. C.F. Industries has two CO_2 plants in Louisiana. These two facilities recover CO_2 from flue gas and from other operations, such as ammonia. Cherokee Associates has operations close to Jackson Dome and owns part of the Choctaw pipeline. Liquid Carbonics company was listed as a commercial source of CO_2 for one of Chevron's projects in Timbalier Bay. For its project in Olla field, Hunt obtained CO_2 by unknown means from Black Lake field. Shell, for its project in Week's Island field, used CO_2 via pipeline from Jackson Dome.

Economic Screening

The proposed screening method considers the economic feasibility of the process. The economic screening was based on before-tax, present-worth benefit to cost ratio. The economic evaluation relied heavily on data and experience gained from similar projects. Data specific to the reservoir at hand was limited to initial oil in place, area, depth, number of wells, distance to the CO_2 source, and the ranking characteristic parameter calculated in the technical screening phase.

In determining the project's costs, it was assumed that the CO_2 project could take advantage of the existing infrastructure. It was also assumed that the operating cost is charged to the CO_2 project. This last assumption implies that production from the candidate reservoir is at or near the economic limit.

TABLE 4: CO_2 Projects Identified from Office of Conservation

Texaco:	Lake Barre (LB UP MS RD SU) - 3/84
	West Cote Blanche Bay (W CBB 14 RBX SU) - 3/84
	Bayou Sale (BS St. Mary RDS SU) - 3/84
	Paradis (PAR Paradis RTSU) - 3/84
	Lafitte (LFT 8900 RMKA SU) - 5/84
	Paradis (PAR LWR 9000 RM SU) - 1/80
	Paradis (PAR 8 RA SU) - 1/80
	Paradis (PAR 9500 RC7 SU) - 4/89
	Paradis (16 SD RAB-1) - 2/89
	Paradis (PAR PZ RU SU) - 5/90
	Paradis (PAR 10000 RU SU) - 5/90
ARCO:	Jeanerette (JEN Q RA VU) - 7/84
	Jeanerette (JEN UR RA VU) - 7/84
Shell:	White Castle (WC MW RA SU) - 3/86
	Weeks Island (R RA SU) - 9/86
	Weeks Island (S RA SU) - 9/86
Chevron:	Timbalier Bay (TB 4900 RBASU) - 1/87, [currently owned by Greenhill Petroleum]
	Quarantine Bay (QB 4 RC SU) - 8/81
	Timbalier Bay (TB S-2B RA SU) - 9/83, [currently owned by Greenhill Petroleum]
	Bay Marchand Blk 2 (2500' A - 7/90
	Bay Marchand Blk 2 (3150'-3200' A) - 7/90
	Bay Marchand Blk 2 (3400' RB) - 3/91
Hunt	Olla (OL 2800 Wilcox RA SU) - 10/82

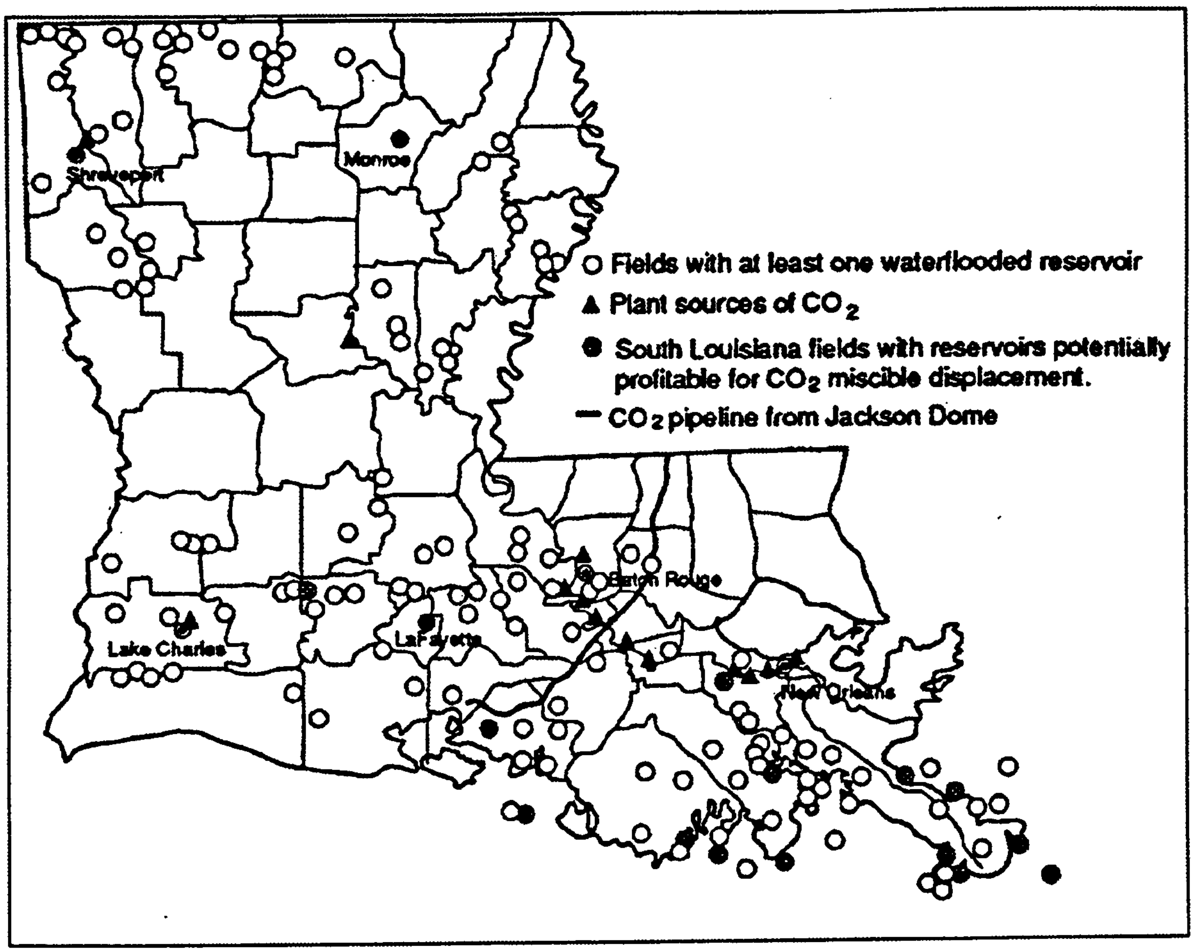


Figure 1. Potential candidates for CO_2 miscible displacement in Louisiana

Production Schedule. Studies[33,39,59-62] of several field-scale CO_2 projects concluded that vastly different projects exhibit similar production responses to CO_2. Based on these studies, the potential recovery of the CO_2 process when applied to an optimum reservoir is estimated to be 15% of the original oil in place, N. The potential recovery from the reservoirs in the database is obtained by multiplying 15% by the original oil in place, by the ranking parameter, R_i. This is expressed as:

$$N_{pi} = 0.15 * N * R_i \qquad (5)$$

The potential recovery is produced according to the schedule shown in Figure 2. The expected life of the project is taken to be 15 years. The annual revenues are calculated using the schedule with the price of oil set at $17/STB.

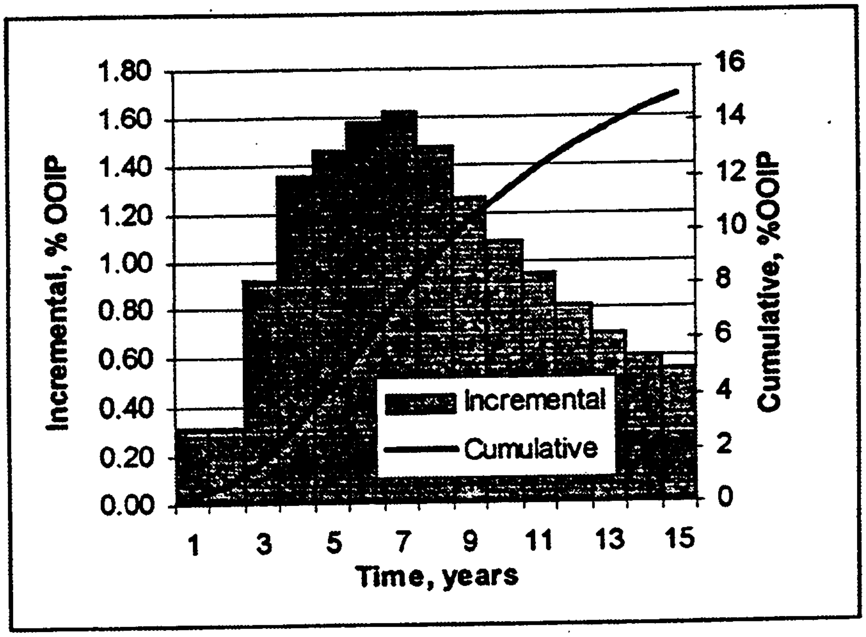


Figure 2. Typical production schedule for CO_2 miscible displacement

Capital Outlay. The capital needed to start a CO_2 project is field dependent. However, estimates using typical costs are acceptable for the purpose of screening. Capital outlay considered in this screening were of required new wells, pipeline to the CO_2 source, and injection and production equipment. Other equipment was assumed to be available as part of the existing infrastructure. Drilling and completion cost, c_d, was estimated using the following equation developed in a DOE study:[16,48]

$$\text{for onshore wells, } c_d = 30{,}430 * n * e^{0.00035D}, \tag{6}$$

$$\text{and for offshore wells, } c_d = 688{,}514 * n * e^{0.0001D} \tag{7}$$

where c_d is the drilling and completion cost, in U.S. dollars;

D is the formation depth in feet; and

n is the number of required new wells.

The number of required new wells depends on the optimum spacing and the number of active wells. It is estimated from:

$$n = \frac{A}{s} - n_a \tag{8}$$

where A is the reservoir area in acres;

n_a is the number of active wells, and

s is the optimum spacing.

For the purpose of screening s is assumed to be 40 acres for onshore reservoir and 80 acres for offshore reservoirs. The number of total wells, n_t, should not be less than two, an injector and a producer, or:

$$n_t = n + n_a \geq 2 \tag{9}$$

Injection and production equipment costs, c_{inj} and c_{pd} respectively, were estimated from the same DOE study using the equations:[16,48]

$$c_{inj} = 22{,}892 n_{inj} e^{0.00009D} \quad (10)$$

and

$$c_{pd} = 24{,}908 n_p e^{0.00014D} \quad (11)$$

where D is the formation depth in feet;

n_p is the number of producers; and

n_{inj} is the number of injection wells, which is taken to be half of the total number of wells.

CO_2 can be transported by tank truck, railcar, or pipeline. Transportation by pipeline is considered the least expensive of all these methods.[5] Depending on the pipeline pressure conditions, CO_2 can be transported either at subcritical or supercritical conditions or as a liquid. The supercritical CO_2 pipeline system is the most economical system for transporting the large quantities of CO_2 needed for enhanced oil recovery.[60] The following equation can be used to estimate the cost of pipeline:[16,48]

$$C_{pip} = (100{,}000 + 2{,}008\ q_{inj}^{0.834})\ d, \quad (12)$$

where C_{pip} is the pipeline cost in U.S. dollars;

d is the distance to the Shell pipeline, in miles; and

q_{inj} is the estimated CO_2 pipeline capacity, in MMSCF/D.

q_{inj} is estimated from the following correlation:[16,48]

$$q_{inj} = 2 * N_{pi} \tag{13}$$

where N_{pi} is the projected incremental oil in million STB estimated by Equation 5.

If more than one reservoir is located in the same field, the pipeline cost is shared. The pipeline capacity is calculated from Equation 13 using the incremental production from all the reservoirs to share the cost. The pipeline cost, c_{pip}, calculated from Equation 12 is then shared between the reservoirs on the basis of the individual incremental oil value.

All capital outlay is charged during the first year of the project.

CO_2 Cost. Published studies suggest that 6 MSCF per STB of incremental oil is a representative average value of CO_2 utilization.[59,61] The purchase of CO_2 is a major expense for miscible projects, especially if CO_2 is obtained from industrial sources. The CO_2 cost for the purpose of this screening was based on availability from natural sources via the Shell pipeline. The CO_2 cost was estimated at $0.60/MSCF and remained constant throughout the injection period. The CO_2 project was not burdened with separation and recycling costs. It is assumed that the value of produced natural gas would offset the cost of CO_2/natural gas separation.

Operating Costs. Operating costs are site and operator specific. The average annual operating cost, c_{op}, in U.S. dollars, however, can be predicted from the following equation:[13,54]

$$c_{op} = 13{,}298 n_t e^{0.0001D} \tag{14}$$

It is assumed that all wells will require future workovers at an average of 0.25 workovers per well per year.[60] The cost of a workover is estimated to be half the cost of the equipment. The annual workover cost, c_{wo}, can then be determined using the following equation:

$$c_{wo} = 0.25\left(\frac{n_t}{2}\right)\ (c_{inj} + c_{pd}), \tag{15}$$

where c_{inj} and c_{pd} are expressed by equations 10 and 11, respectively.

Both the technical and economic screening algorithms were written in FORTRAN™ code. The economic screening may also be run on an electronic spreadsheet. The FORTRAN™ code and a user manual are in Appendix B.

Louisiana Waterflooded Reservoirs Database

The approach described in this paper was used to screen waterflooded reservoirs in Louisiana. These reservoirs are listed in a database available from the Louisiana Office of Conservation and Reserves. Initially, the database listed 499 reservoirs that were waterflooded. These reservoirs represented a total initial-oil-in-place of 5.289 billion STB, or an average of 10.6 million STB/reservoir.

Many reservoirs were eliminated in the initial stage of screening for various reasons. Because of the high cost of transporting CO_2, all of the 101 reservoirs located in North Louisiana were eliminated. An additional 188 reservoirs, mostly inactives were eliminated because current saturation and pressure data, two key screening parameters were unavailable. Inconsistent data also led us to eliminate 13 reservoirs, leaving 197 reservoirs for screening and ranking. A listing of these 197 reservoirs together with available data are given in Appendix C.

Screening Results

Table 5 lists Louisiana fields with reservoirs in the top 100 technical rank. Table 6 lists the 50 top economically ranked reservoirs and their relevant data. The reservoirs are ranked based on present worth benefit to cost ratio. The economic evaluation considered shared pipeline cost.

As expected, the final ranking did not correlate with the technical ranking parameter, R_i. Under the conditions established for the model, the majority of possible candidates are not economically suitable for CO_2 miscible displacement. Only 12% of the reservoirs in the database look economically attractive. Nevertheless, the potential incremental oil from these reservoirs is a significant 72.6 MMSTB of oil.

The validity of the screening approach is demonstrated by the fact that current CO_2 projects contained in the database are highly ranked. Texaco's Paradise Field projects in the Lower 9000 Sand and Main Pay RT-SU are ranked first and fifth respectively. Shell's project is the South Pass Block 27 field, "N46" RC SU, is ranked thirteenth. These cases were considered technically and economically feasible by the operator prior to the implementation of the process.

The process economics is dependent on are well spacing, oil price, CO_2 price, and discount rate. A sensitivity analysis was conducted. A summary of this analysis is given in Table 7.

TABLE 5: Fields with Reservoirs in Top 100 Technical Rank

Bay Marchand Block 2	Livonia
Black Bayou	Lockhart Crossing
Bully Camp	Main Pass Block 69
Burrwood	Manila Village
Caillou Island	Plumb Bob
Clovelly	Port Barre
Dave Haas	Quarantine Bay
Delta Duck Club	South Pass Block 24
Dog Lake	South Pass Block 27
Eugene Island Block 18	Southeast Pass
Frisco	Tepetate
Garden City	Timbalier Bay
Garden Island Bay	Valentine
Grand Bay	Vatican
Hurricane Creek	Ville Platte
Lake Barre	West Bay
Lake Hatch	West Cote Blanche
Leeville	West Delta Block 83
Little Lake	West White Lake
Livingston	

TABLE 6. Potentially Profitable Reservoirs for CO_2 Miscible Displacement in Louisiana

Base case: 197 reservoirs with complete information

Prospect Identification			Reservoir Parameters				Screening Parameters								Tech.	Economic Parameters			Rank
Operator	Field	Reservoir	Depth Feet	EOOIP MMBbl	Recov. MMBbl	Area Acres	API	Temp o F	Perm, K, md	So %	P/MMP	Poros. %	H oil Feet	dip o	Rank	Wells Now	New Wells	Shared Dist, mi	40/80 15 %
Texaco	Paradise	Lower 9000 Sand RM	10450	13.5	1.7	235	35.7	193	515	62.0	0.909	28.8	45	8	85.04	6	0	1.0	1.14
Hassie	South Pass Block 24	8800' RD	8295	36.7	3.1	960	30.0	178	447	61.0	0.341	26.0	39	3	55.79	12	0	11.6	1.04
Shell	South Pass Block 27	"N1b" Reservoir F Sand unit	7300	3.7	0.2	70	28.0	165	537	43.5	0.478	30.0	35	7	42.99	1	0	1.4	0.96
Shell	Eugene Island Block 18	"O" Sand	10071	35.6	4.1	273	38.5	151	1000	31.3	1.866	32.0	80	4	76.50	3	0	59.0	0.95
Texaco	Paradise	Main Pay RT SU	10300	11.7	1.3	114	36.8	205	1910	51.7	0.752	27.5	51	10	74.25	2	1	1.0	0.93
Shell	South Pass Block 27	"M" RB SU	7500	7.4	0.7	150	32.4	178	200	47.5	0.465	30.0	40	9	60.03	3	0	3.9	0.89
Shell	South Pass Block 27	"N1b" Reservoir C Sand Unit	7450	9.2	0.6	211	32.0	168	300	22.9	0.616	33.0	28	5	44.22	3	0	3.5	0.82
Texaco	Caillou Island	Upper 8000 RA SU	7900	6.4	0.6	182	38.2	103	285	17.1	1.484	31.0	25	18	58.62	2	0	8.0	0.76
Shell	South Pass Block 27	"N1a" Reservoir C Sand unit	7350	14.4	1.1	328	32.0	168	300	36.9	0.340	33.0	27	5	49.67	6	0	8.2	0.72
Gulf	West Bay	Proposed WB6B (RG) Sand Unit	7419	49.7	3.6	530	31.3	80	470	38.4	1.306	32.6	41	5	48.52	5	2	29.9	0.71
Shell	South Pass Block 27	Proposed SPB 27 K RA SU	6200	4.1	0.3	174	27.5	160	500	54.4	0.484	28.0	17	10	48.61	2	0	1.7	0.69
Gulf	West Bay	5 A 'B'	7000	2.6	0.2	74.2	33.0	104	500	39.1	0.774	31.5	23	8	48.39	1	0	1.6	0.68
Shell	South Pass Block 27	"N4b" RC SU	7600	7.4	0.5	157	26.6	172	400	48.6	0.312	30.0	34	5	43.61	3	0	2.8	0.63
Shell	South Pass Block 27	"N1b" Reservoir D Sand Unit	7350	3.6	0.2	102	27.0	161	300	29.0	0.444	33.0	24	3	28.74	1	0	0.9	0.61
Shell	South Pass Block 24	Reservoir A, "Q" Sand	8125	17.0	1.7	516	39.5	186	500	21.5	1.161	32.0	24	2	66.09	5	1	6.4	0.61
Shell	South Pass Block 27	"M2" Reservoir A Sand Unit	6775	39.0	3.4	691	29.5	162	400	57.4	0.574	33.0	39	3	58.15	6	3	19.7	0.58
Shell	South Pass Block 27	"M6" Reservoir A Sand Unit	6750	22.9	1.2	360	27.0	159	600	33.9	0.479	33.0	41	4	34.24	9	0	6.8	0.52
Shell	South Pass Block 27	"N1b" Reservoir B Sand Unit	7550	3.5	0.1	116	26.8	168	300	26.7	0.329	33.0	22	2	26.03	1	0	0.8	0.48
Shell	South Pass Block 24	RA P-Q Sand	7860	44.2	3.8	1574	35.0	167	300	24.3	0.555	30.0	15	2	57.34	18	2	14.3	0.46
Shell	South Pass Block 27	"N1b" Reservoir E Sand Unit	7000	25.3	1.5	434	26.0	160	500	44.8	0.279	33.0	33	3	40.31	3	2	8.9	0.31
Shell	South Pass Block 24	8000' RS SU (Horstal "S")	8150	14.6	1.1	577	32.0	176	500	42.2	0.362	29.0	24	3	52.39	11	0	4.3	0.27
Gulf	Quarantine Bay	9BC, C2	9430	3.1	0.3	90	35.9	200	200	32.0	0.946	28.0	20	2	60.63	1	0	6.4	0.26
Chevron	Bay Marchand Blk 2	3650' Upper Block D, 3650' (U)	3850	26.8	0.8	167	24.0	136	570	11.4	0.352	32.0	78	17	16.99	2	0	24.0	0.24
Chevron	South Pass Block 24	8200' "T" Sand	8294	84.3	6.4	1456	32.0	104	325	43.2	0.819	31.8	45	2	50.96	9	9	24.2	0.24
Shell	South Pass Block 24	Res. A "T1a" Sand	8700	12.3	0.7	374	30.0	175	300	32.3	0.725	32.0	23	2	39.59	7	0	2.8	0.21
Shell	South Pass Block 27	"N2" Reservoir B Sand Unit	7500	2.4	0.1	119	27.0	94	380	41.4	0.667	29.0	18	6	25.96	1	0	0.5	0.20
Shell	South Pass Block 27	"N4b" Sand Reservoir B	7850	10.9	0.4	302	24.2	168	400	22.7	0.237	31.0	35	3	24.22	4	0	2.3	0.20
Texaco	West Cote Blanche Bay	Lower No. 11 Sand, Reservoir N3	8600	7.0	0.6	40	33.8	108	1200	36.4	1.495	33.0	84	27	59.13	1	1	1.2	0.14
Texaco	West Cote Blanche Bay	No. 17 Sand. Res. P-Q	7700	4.7	0.5	75	33.1	116	400	44.1	1.314	28.0	42	20	66.76	0	1	0.9	0.12
Texaco	Paradise	Paradis Zone, Seg. A-B	10000	119.0	14.6	2057	38.0	200	1348	60.0	0.872	26.2	55	4	81.73	8	43	1.0	0.10
Chevron	South Pass Block 24	6600' RA Sand Unit	8721	85.3	7.0	1496	32.4	179	500	35.7	0.734	31.0	43	2	54.95	7	12	26.5	0.09
Shell	South Pass Block 27	"N1a" Reservoir E Sand Unit	7000	21.2	0.9	529	26.0	160	500	31.5	0.391	33.0	22	3	28.49	6	1	5.3	0.06
Gulf	Grand Bay	GB 10B (FBB) RA SU	7870	7.7	0.7	440	35.3	98	300	23.9	1.402	32.8	11	2	56.17	6	0	10.5	0.05
Gulf	West Bay	11 Sand Fault Block B	10650	26.2	2.4	436	30.0	136	500	47.3	1.163	30.0	55	3	60.26	2	3	19.7	0.05
Shell	South Pass Block 27	"N1c" Reservoir E Sand Unit	7000	10.5	0.4	347	26.0	160	200	22.3	0.451	33.0	23	3	23.00	5	0	2.1	0.05
Texaco	Caillou Island	9400 ft Sand, RBB1C	10000	23.3	2.3	427	39.0	136	1900	17.3	1.113	30.0	44	12	64.42	2	3	23.8	0.03
Shell	South Pass Block 27	SPB27 L4 RD SU	7430	2.2	0.1	120	32.0	93	300	43.9	0.569	32.0	16	8	43.09	2	0	0.8	0.02
Gulf	Quarantine Bay	8 Sand, Reservoir "B"	8950	17.0	1.3	303	34.5	112	1669	22.1	1.102	32.0	28	3	50.43	3	1	29.0	0.01
Shell	South Pass Block 27	"M2" Reservoir B Sand Unit	6280	8.9	0.3	142	25.0	155	500	14.4	0.463	33.0	32	4	23.60	5	0	1.8	0.00
Shell	South Pass Block 27	Reservoir "A" "L2" Sand Unit	6420	30.2	1.1	992	25.6	153	500	20.1	0.324	33.4	33	3	24.01	18	0	6.3	-0.04

TABLE 7: Summary of the Sensitivity Analysis for Ranking of Candidate Reservoirs for CO_2 Miscible Displacement in Louisiana

Parameter	Spacing, Onshore/Offshore				Discount Rate			Oil Price, $/Bbl			CO2 Price, $/Mcf		
	20/40	40/40	40/80	80/160	12%	15%	20%	15	17	20	0.6	0.8	1.0
Attractive Reservoirs	5	8	39	73	41	39	27	28	39	47	39	32	27
Potential Oil, MMBbls	6.9	24.5	70.6	110.4	74.6	70.6	39.7	40.3	70.6	86.3	70.6	63.3	39.6

Specific Reservoir Performance

The objective of reservoirs screening and ranking is to attract the attention of operators to the potential of the miscible CO_2 EOR process in their own waterflooded reservoirs. Once this is accomplished, it is presumed that the operator will be interested in the absolute performance of a specific reservoir as opposed to its ranking relative to other reservoirs in the database. A user-friendly numerical simulator allows the screening of different implementation options. The effects of reservoir heterogeneity and well locations, which were not included in the initial screening, can be considered. Additional parameters can also be included in the simulation. CO_2-PROPHET software is selected to perform this task.[56]

CO_2-PROPHET, a water-and gas-flood prediction software product, has been developed by Texaco with support of the U.S. Department of Energy. CO_2-PROPHET has been shown to be a good tool for screening and reservoir management and is being released with a detailed user manual to the industry. The hardware required to run CO_2-PROPHET are an Intel® 386-based PC or better with at least 4 megabytes of RAM and 4 megabytes of free disk space. A math co-processor is required for 386 or 486SX systems.[56]

CO_2-PROPHET runs on PC compatible computers. Some of its features include: easy reservoir parameter input; several predefined patterns to simplify use; the ability to design patterns to fit most situations; fast computation; multiple flood regimes that model water, gas and miscible floods; output in surface units and dimensionless formats; and output designed for importing data into a spreadsheet.[56]

CO_2-PROPHET computes streamlines between injection and production wells to form stream tubes. It then makes flow computations along the stream tubes. It uses the Dykstra-Parsons coefficient to distribute the initial injection into a maximum of ten layers. A new case can be set up and run in a few minutes, making this program ideal for screening of EOR projects and pattern comparisons.

The use of CO_2-PROPHET is demostrated in one of the top-ranked reservoirs, refered to as Eden. The Eden reservoir is located in a salt dome related structure. Its initial pressure in 1949, when commercial development was initiated, was 4500 psi. The reservoir had a large initial gas cap about 0.444 the size of the oil zone. The estimated original-oil-in-place was 11.7 million barrels of 35.2 API gravity oil. By 1972, the reservoir had produced 2.6 millions of barrels of oil, mostly due to gas cap expansion. In 1974, a waterflooding program was initiated to increase recovery. As of 1990, waterflooding resulted in the recovery of 4.3 millions barrels of oil.

The Eden reservoir was simulated using an option that allowes for the development of stream tube model which is stored for later investigation of implementation options. Figure 3 shows the stream tube model of the Eden reservoir and well locations. Table 8 lists the reservoir and simulation parameters for Eden. A summary of the main assumptions used in this study is presented in Table 9. Basically they consist of the limitations inherent in the model itself, the assumptions used for missing data, and economic assumptions necessary to evaluate the project.

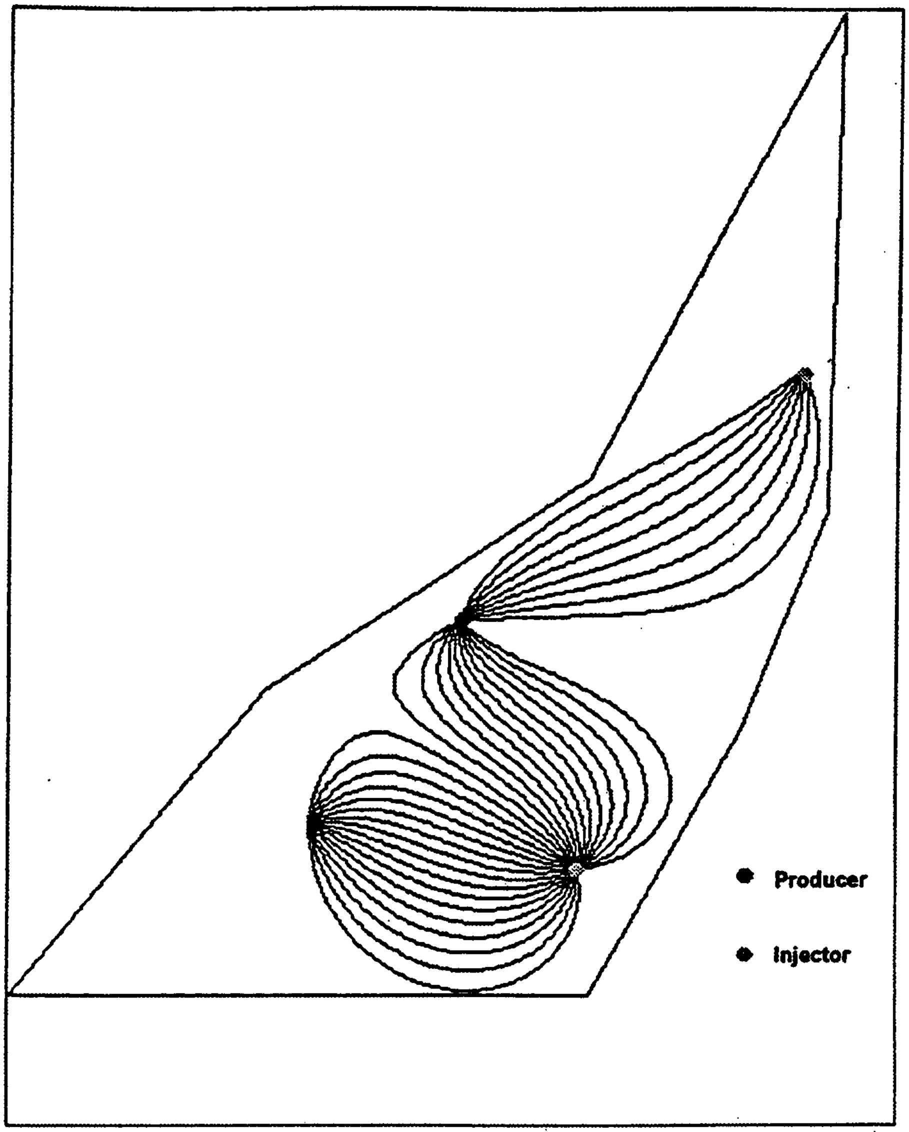


Figure 3. Streamline model for simulation of CO_2 miscible displacement at Eden reservoir.

TABLE 8: Reservoir and simulation parameters. Eden field

RESERVOIR PARAMETERS

OOIP, MMBls	11.723
Permeability, md	1910
Temperature, F	205
Dip angle, o	10
Gravity, API	35.2
MMP, psi	3500
Dykstra- Parsons	0.75
C5+ MW	230.3
Swc, %	14
Rs. scf/stb	900
Oil viscosity, cp	0.35
Bo, rb/stb	1.4
Gas gravity	0.7
Water viscosity, cp	0.8
Salinity, ppm	100000
Mixing Parameter	0.6666
Area, sf	3841632
Thickness, ft	139.5
Porosity, %	20
Kh/Kv	0.1

SIMULATION PARAMETERS
RELATIVE PERMEABILITIES

Layers	3
Pattern	Custom
Krocw	1
Kwro	0.116
Krsmax	0.477
Krgcw	0.477
Nw	2
Now	2
Ns	2
Ng	2
Nog	2
Sorw	0.3
Sorg	0.3
Sorm	0.05
Sgr	0.3
Ssr	0.3

SIMULATION RUNS

WF & CO2 HYBRID

Pre- wf pres, psi	3335
Pre -wf So, %	0.517
Water inj, hcpv	0.7
CO2 slug, hcpv	0.125
WAG (CO2 hcpv)	0.3
WAG ratio (vol)	2
Chase water, hcpv	0.3
Qw inj. bpd/w	1000
QCO2, MMscf/d/w	6.2 & 8.0

WATERFLOODING

Pre- wf pres, psi	1484
Pre -wf So, %	0.517
Water inj, hcpv	1.25
Qw inj, bpd/well	1000

INITIAL CO2 HYBRID

Pre-co2 pres, psi	3335
Pre-co2 So, %	0.517

TABLE 9: Reservoir Assumptions for Paradis Main Pay RT-SU Reservoir.

MODEL ASSUMPTIONS	RESERVOIR ASSUMPTIONS	ECONOMIC ASSUMPTIONS
• Homogeneous formation • Dykstra Parsons = 0.7 • Kv/Kh = 0.1 • Mixing parameter = 0.6666 • Thickness & porosity adjusted to match estimated OOIP • No gravity effects.	• Relative permeability parameters. • Gas saturation negligible • Production & injection potentials constant. • No matching of previous performance attempted. • Initial conditions estimated from volumetrics. • Reservoir already pressured.	• Constant oil and CO_2 prices ($17 & $0.7). • Constant capital & operating costs. • Project's life 20 years • 100 % net revenue interest • Discount rate 12 %. • Gas severance tax 0.07 $/MCF • Oil severance tax 15 %

Two implementation options were investigated, waterflooding and waterflooding followed by hybrid CO_2 displacement. For the waterflooding option, the startup conditions were those existing in 1974 at the end of the primary recovery phase. A total of 1.25 pore volumes (P.V.) of water were injected in the waterflooding option.[63] The hybrid CO_2 process started after 0.7 P.V. of water was injected. The performances of the two options are compared in Table 10 and Figure 4.

Conclusions

A screening model was developed to rank a large number of potential reservoirs in a short period of time and with little effort. The model provides a rapid evaluation of both the technical and economic feasibility of the CO_2 miscible process. CO_2-PROPHET was found to be a user-friendly tool that can complement the screening model. CO_2-PROPHET can incorporate site-and operator-specific data that are not considered in the initial screening.

The results of this investigation are summarized in SPE 35431, a paper presented at the SPE Improved Oil Recovery Symposium held in Tulsa, OK, 21-24 April, 1996. A copy of the paper is appended.

TABLE 10: Comparison of Alternatives of Development for Eden Reservoir

ALTERNATIVE	WATERFLOOD	WATERFLOOD & CO_2 HYBRID
Total recovery time	27.1	36.9
HCPV injected	1.25	2.025
Recovery % OOIP	19.37	37.45
Oil recovery MMBls	2.27	4.39
HCPV injected at 20th year	0.92	1.03
Recovery at 20th year, %OOIP	17.75	26.96
NPV at 20th year, MM$	50.6	24.6
IRR	>1000	>1000
Benefit/Cost Ratio	12	17.43

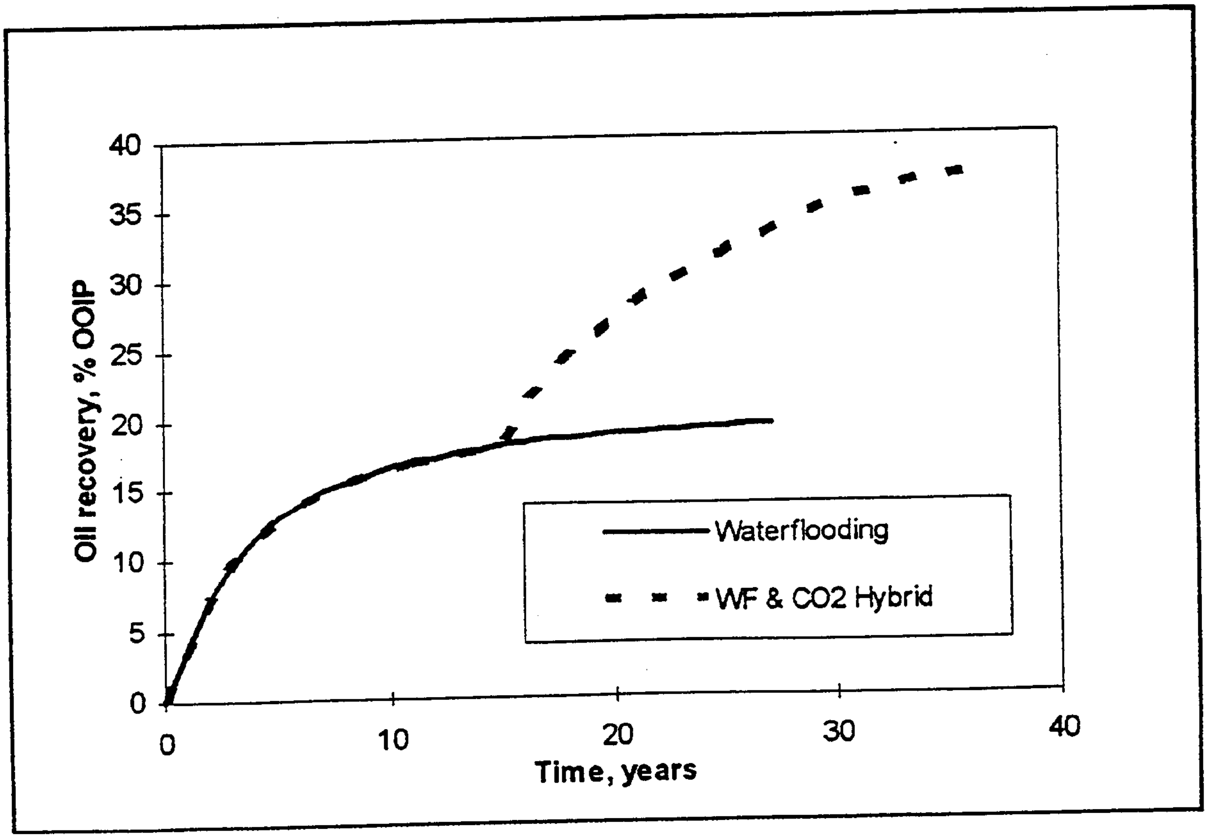


Figure 4. Comparison of alternatives of development for Eden reservoir

References

General Field Experience

1. Moritis, G.: "EOR Dips in U.S. but Remains a Significant Factor", *Oil & -Gas J.* (Sep. 26, 1994) 51-79.

2. Hadlow, R. E.: "Update of Industry Experience with CO_2 Injection", paper SPE 24928 presented at the 1992 SPE Annual Technical Conference and Exhibition, Washington D.C., Oct. 4-7.

3. Mungan, N.: " An Evaluation of Carbon Dioxide Flooding," paper SPE 21762 presented at the SPE Western Regional Meeting, Long Beach, March 20 - 22, 1991.

4. Mungan, N.: "Enhanced Recovery Under Constrained Conditions," *JPT* (Aug. 1990) 962-964.

5. Brock, W. R. and Bryan, L. A.: " Summary Results of CO_2 EOR Field Tests, 1972 - 1987," paper SPE 18977 presented at the SPE Joint Rocky Mountain Regional/ Low Permeability Reservoirs Symposium and Exhibition, Denver, March 6 - 8, 1989.

6. Mungan, N.: "Enhanced Oil Recovery Using Water as a Driving Fluid. Part 6 - Fundamental Aspects of Carbon Dioxide Flooding", *World Oil* (Aug., 1981) 69-84.

7. Goodrich, J. H.: " Review and Analysis of Past and Ongoing Carbon Dioxide Injection Field Tests," paper SPE 8832 presented at the SPE/DOE Sixth Symposium on Improved Oil Recovery, Tulsa, April 20 - 23, 1980.

CO_2 Miscible Displacement Fundamentals

8. Holm, L. W. and Josendal, V. A.: "Mechanisms of Oil Displacement By Carbon Dioxide", *JPT* (Dec. 1974) 1427-1436.

9. Stalkup, F. I.: " Carbon Dioxide Miscible Flooding: Past, Present, and Outlook for the Future," *JPT* (Aug. 1978) 1102-12.

10. Metcalfe, R. S. and Yarborough, L.: " The Effect of Phase Equilibria on the CO_2 Displacement Mechanism", *SPEJ* (Aug. 1979) 242-252-.

11. Leach, M. P. and Yellig, W. F.: " Compositional Model Studies - CO_2/Oil - Displacement Mechanisms", *SPEJ* (Feb. 1981) 89 - 97.

12. Mungan, N.: "Enhanced Oil Recovery Using Water as a Driving Fluid. Part 7 - Field Applications of Carbon Dioxide Flooding," *World Oil* (Sep., 1981), 155 - 172.

13. Klins, M. A.: *Carbon Dioxide Flooding*, IHRC, Boston (Sep, 1984).

14. Holm, L. W., "Miscibility and Miscible Displacement", *JPT* (Aug. 1986) 817-818.

15. Holm, L. W., "Evolution of the Carbon Dioxide Flooding Process", *JPT* (Nov. 1987) 1337-1342.

16. Martin, F. D. and Taber, J. J.: "Carbon Dioxide Flooding", *JPT* (April 1992) 396-400.

MMP Correlations

17. Yellig, W. F. and Metcalfe, R. S.: "Determination and Prediction of the CO_2 Minimum Miscibility Pressures," *JPT* (Jan. 1980) 160-68.

18. Alston, R. B., Kokolis, G. P., and James, C. F.: "CO_2 Minimum Miscibility Pressure: A Correlation for Impure CO_2 Streams and Live Oil Systems," paper SPE 11959 presented at the 1983 SPE Annual Technical Conference and Exhibition, San Francisco, Oct. 5-8.

19. Holm, L. W. and Josendal V.A.: "Study Shows Best Use of CO_2 as EOR Agent," *Oil & Gas J.* (Oct. 22, 1984) 131-134.

20. Sebastian, H. M., Wenger, R. S., and Renner, T. A.: "Correlation of Minimum Miscibility Pressure for Impure CO_2 Streams," *JPT* (Nov. 1985) 2076-82.

21. Orr, F. M. Jr. and Silva, M.K.: "Effect of Oil Composition on Minimum Miscibility Pressure-Part 2: Correlation," *SPERE* (Nov. 1987) 479-91.

Field Applications

22. Smith, D. L.: " Computer Graphical Analysis Method Proves Beneficial in Lost Soldier Field Deviated Well Application," *JPT* (June 1982)1186.

23. Rickford, R. L. and Finney, T. P.: " Formation Damage From Fine Particulate Invasion: An Example From the Lost Soldier Tensleep Formation," *SPEPE* (Aug. 1991) 247.

24. Kleinstelber, S. W.: " The Wertz Tensleep CO_2 Flood : Design and Initial Performance," *JPT* (May 1990) 630 - 636.

25. Winzinger, R. *et. al.* : " Design of a Major CO_2 Flood, North Ward Estes Field, Ward County, Texas," *SPE Reservoir Engineering* (Feb. 1991) 11 - 16.

26. Hsie, J. C. and Moore, J. S.: " The Quarantine Bay 4RC CO_2 WAG Pilot Project : A Postflood Evaluation," *SPE Reservoir Engineering* (Aug. 1988) 809 - 814.

27. Graue, D. J. and Zana, E. T.: " Study of a Possible CO_2 Flood in Rangely Weber," *JPT* (July 1981) 1312 - 1318.

28. Hervey, J. R. and Iakovakis, A. C.: " Performance Review of a Miscible CO_2 Tertiary Project: Rangely Weber Sand Unit, Colorado," paper SPE 19653 presented at the 1989 SPE Annual Technical Conference and Exhibition, San Antonio, Oct. 8 - 11.

29. Philips, L. A. Mc Pherson, J. L. and Leibrecht R. J.: " CO_2 Flood : Design and Initial Operations, Ford Geraldine (Delaware Sand) Unit," paper SPE 12197 presented at the 1983 SPE Annual Technical Conference and Exhibition, San Francisco, Oct. 5 - 8.

30. Pittaway, K. R. and Rosato, R. J.: " The Ford Geraldine Unit CO_2 Flood - Update 1990," *SPE Reservoir Engineering* (Nov. 1991) 410 - 414.

31. Trash, J. C.: " Twofreds Field : A Tertiary Oil Recovery Project," paper SPE 8382 presented at the 1979 SPE Annual Technical Conference and Exhibition, Dallas, Sept. 23 - 26.

32. Kirkpatrick, R. K., Flanders, W. A. and DePauw, R. M.: " Performance of the Twofreds CO_2 Injection Project," paper SPE 14439 presented at the 1985 SPE Annual Technical Conference and Exhibition, Las Vegas, Sept. 22 - 25.

33. Flanders, W. A. and DePauw, R. M.: " Update Case History : Performance of the Twofreds Tertiary CO_2 Project" paper SPE 26614 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3 - 6.

34. Simlote, V. N. and Withjack, E. M.: " Estimation of Tertiary Recovery by CO_2 Injection - Springer A Sand, Northeast Purdy Unit." *JPT* (May 1981) 808 - 818.

35. Brinlee, L. D. and Brandt, J. A.: " Planning and Development of the Northeast Purdy Springer CO_2 Miscible Project," paper SPE 11163 presented at the 1982 SPE Annual Technical Conference and Exhibition, New Orleans, Sept. 26 -29.

36. Fox, M. J., Simlote, V. N. and Beaty, W. G.: " Evaluation of CO_2 Flood Performance, Springer A Sand, NE Purdy Unit, Garvin County, OK," paper SPE 12665 presented at the SPE/DOE Fourth Symposium on Enhanced Oil Recovery, Tulsa, April 15 -18, 1984.

37. Fox, M. et. al.: " Review of CO_2 Flood, Springer "A" Sand, Northeast Purdy Unit, Garvin County, Oklahoma," SPE Reservoir Engineering (Nov. 1988) 1161 - 1167.

38. Hansen, P. W. : " A CO_2 Tertiary Recovery Pilot : Little Creek Field, Mississipi," paper SPE 6747 presented at the 1977 SPE Annual Technical Conference and Exhibition, Denver, Oct. 9 - 12

39. Flanders, W. A., Stanberry, W. A. and Martinez, M.: "CO_2 Injection Increases Hansford Marmaton Production," *JPT* (Jan. 1990) 68 - 73.

40. Youngren, G. K. and Charlson, G. S.: " History Match Analysis of the Little Creek CO_2 Pilot Test," *JPT* (Nov. 1980) 2042 - 52.

41. Davis, D. W.: " Project Design of a CO_2 Miscible Flood in a Waterflooded Sandstone Reservoir." paper SPE 27758 presented at the SPE/DOE Ninth Symposium on Improved Oil Recovery, Tulsa, April 17 -20, 1994.

42. Kumar, R. and Einbeck, J. N.: " CO_2 Flooding a Waterflooded Shallow Pensilvanian Sand in Oklahoma : A Case History," paper SPE 12668 presented at the SPE/DOE Fourth Symposium on Enhanced Oil Recovery, Tulsa, April 15 -18, 1984.

43. Hoiland, R. C., Joyner, H. D., and Stalder, J. L.: " Case History of a Succesful Rocky Mountain Pilot CO_2 Flood," paper SPE 14939 presented at the SPE/DOE Fifth Symposium on Enhanced Oil Recovery, Tulsa, April 20 -23, 1986.

44. Brummert, A. C. *et. al.*: " Rock Creek Oil Field CO_2 Pilot Tests, Roane County, West Virginia," *JPT* (March 1988) 339 -347.

Screening Methods

45. Diaz, D. A.: " Screening Criteria for Application of Carbon Dioxide Miscible Displacement in Waterflooded Reservoirs Containing Light Oil," MS Thesis, Louisiana State University, Baton Rouge, Louisiana (1995).

46. Rivas, O., Embid S. and Bolivar, F.: " Ranking Reservoirs for CO_2 Flooding Processes," paper SPE 23641 presented at the 1992 SPE Latin American Petroleum Engineering Conference, Caracas, March 8 -11.

47. Taber, J. J. and Martin, F. D.: " Technical Screening Guides for the Enhanced Recovery of Oil," paper SPE 12069 presented at the 1983 SPE Annual Technical Conference and Exhibition, San Francisco, Oct. 5 - 8.

48. Chung, T. H., Carroll, H.B., and Lindsey, R.: " Application of Fuzzi Expert Systems for EOR Project Analysis," paper SPE 30741 presented at the 1995 SPE Annual Technical Conference and Exhibition, Dallas, Oct. 22 - 25.

Performance Prediction Methods

49. Koval, E. J.: " A Method for Predicting the Performance of Unstable Miscible Displacement in Heterogeneous Media," *SPEJ* (June 1963), 145 -154.

50. Claridge, E. L.: "Prediction of Recovery in Unstable Miscible Flooding", *SPEJ* (April 1972), 143 - 155.

51. Leblanc, J. L. and Caudle, B.H.: " A Streamline Model for Secondary Recovery," paper SPE 2865 presented at the 1970 Biennial Production Techniques Symposium," Wichita Falls, May 14 - 15.

52. Stalkup, F. I., Jr.: " Displacement of Oil by Solvent at High Water Saturation," *SPEJ* (Dec. 1970) 337- 48.

53. Todd, M. R. and Longstaff, W. J.,: " The Development, Testing and Application of a Numerical Simulator for Predicting Miscible Flood Performance," *JPT* (July 1972) 874- 882, *Trans.*, AIME, 253.

54. Lewin and Associates, Inc.: " The Potential and Economics of Enhanced Oil Recovery," prepared under U.S. FEA Contract No. C0-03-50222-000, Washington D.C. (April 1976).

55. Paul, G. W., Lake, L. W. and Gould, T. L.: " A Simplified Model for CO_2 Miscible Flooding," paper SPE 13238 presented at the 1984 SPE Annual Technical Conference and Exhibition, Houston, Sep. 5 - 8.

56. Dobitz, J. K. and Prieditis J.: " A Stream Tube Model for the PC," paper SPE 27750 presented at the SPE/DOE Ninth Symposium on Improved Oil, Tulsa, April 17 - 20, 1994.

Louisiana CO_2 Sources

57. Louisiana Chemical Association : " A Visitor's Guide to the Louisiana Chemical Industry," January 1993.

58. Pine, J.: " SARA Title-3 Database," Louisiana State University, 1993.

Process Economics

59. Flanders, W. A.., McGinnis, R. A., and, Shatto, A. G.: " CO_2 EOR Economics for Small to Medium Size Fields," paper SPE 26391 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3 - 6.

60. Robl, F. W., Emanuel, A. S., and, Van Meter Jr., O. J.: " The 1984 National Petroleum Council Estimate of Potential EOR for Miscible Process," *JPT* (Aug. 1986), 875 - 882.

61. Martin, F. D.: " Enhanced Oil Recovery for Independent Producers," paper SPE 24142 presented at the SPE/DOE Eight Symposium on Enhanced Oil Recovery, Tulsa, April 22-24, 1992.

62. Haynes, H. J. *et. al.*: *Enhanced Oil Recovery*, National Petroleum Council, Washington D. C. (1976).

Waterflooding

63. Willhite, P. G.: Waterflooding, SPE Textbook Series Vol. 3, Society of Petroleum Engineers, Richardson (1986) 208.

APPENDIX A
CO_2 PROVIDERS IN LOUISIANA

AGRICO CHEMICAL COMPANY/FREEPORT-McMORAN
9959 La. 18
St. James, La. 70086
(504) 473-4271
Scott Shean
Chemicals manufactured: sulfuric acid, phosphoric acid, diammonium and monoammonium phosphates, urea.
Consumer uses: fertilizer.

AIR PRODUCTS AND CHEMICALS, INC.
14700 Intracoastal Drive
New Orleans, La. 70129
(504) 254-1590
William Greer
Chemicals Manufactured: Ammonia, carbon dioxide, hydrogen.
Consumer uses: fertilizer (urea products), dry ice, fuel for space shuttle program.

AMERICAN CYANAMID
10800 River Road
Westwego, La. 70094-2040
(504) 431-6436
Jim Dutcher
Chemicals Manufactured: acrylonitrile, aminonitrile, acrlamae, methylmethancralate, acetonitrile, melamine, sulfuric acid, ammonia.
Consumer uses: acrylite, synthetic fibers, ABS plastics.

AMPRO FERTILIZER INC.
P.O. Box 392
Donaldsonville, La. 70346
(504) 473-3976
Bobby K. Shackelford
Chemicals manufactured: anhydrous ammonia
Consumer uses: fertilizer

CF INDUSTRIES
P.O. Box 468
Donaldsonville, La. 70346
(504) 473-8291
Gene T. Lewis
Chemicals manufactured: ammonia, urea ammonia nitrate, urea.
Consumer uses: fertilizer.

DOW CHEMICAL USA
P.O. Box 150
Plaquemine, La. 70765-0150
(504) 389-8236
Chemicals manufactured: caustic, chlorine, chlor-alkali, cellulose, chlorinated methanes, chlorinated polyethylene/glycol ethers, glycol I and II, light hydrocarbon II and III, poly A & B, C, solvents/EDC, vinyl II (over 50 basic chemicals).
Consumer uses: soaps, bleaches, food additives, cosmetics, shampoos, pharmaceuticals, automotive hoses, roofing, brake fluid, antifreeze, adhesives, film, trash bags, Tupperware, pipe, diaper liners, wall paper, herbicides, aerosols, Teflon, solvents, silicones, detergents, milk carton coatings, Handi-wrap, Saran-wrap, ise bags, housewares, margarine tubs.

FARMLAND INDUSTRIES, INC.
P.O. Box 438
Pollock, La. 71467
(318) 765-3574
William White
Chemicals manufactured: anhydrous ammonia
Consumer uses: fertilizer

MONSANTO COMPANY
P.O. Box 174
Luling, La. 70070
(504) 785-3259
Tim Gustafson
Chemicals manufactured: ammonia, activated chlorine/cynauric (ACL/CYA), phosphorous trichloride (PCL3), disodiumiminodisidicacid (DSIDA), APAP (Acetaminophen), Glyphosate, herbicide.
Consumer uses: nylon, chlorine for swimming pools, bleaches, aspirin substitute, herbicides.

OCCIDENTAL CHEMICAL CORPORATION
7377 Hwy. 3214
Convent, La. 70723
(504) 562-9201
Chemicals manufactured: chlorine, caustic soda, ethylene dichlorides (EDC), hydrogen.
Consumer uses: PVC plastics - EDC, water purification, chlorine.

OLIN CORPORATION
P.O. Box 52137
Shreveport, La. 71135
(318) 797-2595
E.E. Warren
Chemicals manufactured: sulfuric acid.
Consumer uses: gasoline, paper, batteries, fertilizer, water purification.

PIONEER CHLOR ALKALI COMPANY INC.
P.O. Box 23
St. Gabriel, La. 70776
(504) 642-1882
Benny L. Bennett
Chemicals manufactured: chlorine, caustic, hydrogen.
Consumer uses: polyvinyl chloride, soap, bleach, pesticides, water treatment chemicals.

TRIAD CHEMICAL
P.O. Box 310
Donaldsonville, La. 70346
(504) 473-9231
Tomm Torr
Chemicals manufactured: ammonia, urea.
Consumer uses: fertilizers.

VULCAN CHEMICAL COMPANY
P.O. Box 227
Geismar, La. 70734
(504) 473-5003
John Waupsh
Chemicals manufactured: chlorine, caustic soda, methyl chloride, chloroform, carbon tetrachloride, perchloroethylene, EDC, methyl chloroform, muriatic acid, hydrogen.
Consumer uses: refrigerents, silicones, dry cleaning, equipment cleaning solvents, food industry (soda pop), pulp and paper.

CONVENT PLANT
Convent, La.

UNION CARBIDE CORP.
P.O. Box 50
Hahnville, La. 70057

INTERNATIONAL MINERALS & CHEMICAL CORP.
Sterlington, La. 71280

FORMOSA PLASTICS CORPORATION
P.O. Box 271
Baton Rouge, La. 70821
(504) 356-3341
Alden L. Andre
Chemicals manufactured: chlorine, caustic soda, ethylene dichlorides (EDC), vinyl chlorides monomer (VCM), polyvinyl chloride (PVC).
Consumer uses: PVC pipe, pool liners, pondliners, shower curtains, tablecloths, raincoats, book binders, air mattresses, waterbeds, etc.

PPG INDUSTRIES INC.
P.O. Box 15
Lake Charles, La. 70602
(318) 491-4500
Tom G. Brown
Chemicals manufactured: chlorine, caustic soda, vinyl chloride monomer, silicas products, chlorinated solvents.
Consumer uses: vinyl plastic, water treatment, paper, aluminum.

APPENDIX B

Screening Model for Application of Carbon Dioxide Miscible Displacement

- User Manual
- Fortran™ Code
- Example Input File for the Screening Model
- Example Output File for the Screening Model

CO29: RESERVOIR SCREENING MODEL FOR CO2 MISCIBLE DISPLACEMENT USER MANUAL

INTRODUCTION

The level of knowledge required to use this program is in the beginners to intermediate level. It demands to have basic knowledge about DOS™ particularly the Editor, some basics of FORTRAN™ and working experience with electronic spreadsheets such as MS EXCEL™ or QUATTRO PRO™.

COMPUTERIZED SCREENING MODEL

The computer program mentioned above was written in FORTRAN™, and is identified as CO29. The model screen technical and economic feasibility of a reservoir database for CO_2 miscible displacement. It basically consists of three files:

CO29.FOR: This is the source code file written in FORTRAN™ language. It is in ASCII format and contains the instructions given by the programmer. This file is known as the source code. In order to make changes in any part of the program, it has to be edited and compiled again.

CO29.OBJ: This is an intermediate file which is used in the preparation of the final executable program (CO29.EXE).

CO29.EXE: This is the program file itself. Just type CO29 and the program begins to work. (assuming required input file is complete and correct).

In order to use this program it is necessary for two data files to exist and be available for program's use in the same directory as CO29. EXE. These two are:

INPUTdb.DAT: Contains the input data for the program, it is prepared in an editor.

OUTPUTdb.DAT: Stores the results obtained from the program.

DATA FILES DESCRIPTION

The **first row** of INPUTdb.DAT file contains the values for the optimum reservoir.

The **second row** contains the values for the worst reservoir at the extreme right of optimum (upper limit), those values come from the database of reservoirs to rank.

The **third row** contains the weighting factor for each parameter.

The **fourth row** contains the values of expected recovery in terms of fraction of Original Oil in Place (OOIP) in a yearly basis for 15 years. It is used in estimating the expected yearly production.

The **fifth row** begins with the listing of reservoirs, first, the data for the ideal reservoir, followed by the listing of the candidate reservoirs to be ranked. It is important to preserve the order of the variables to be input, so the right values are used for each variable.

A description of the variables by columns, included from the fifth row to the end of the INPUTdb.DAT file.

First column: API gravity.

Second column: Temperature, in Fahrenheit degrees.

Third column: Permeability, in milidarcies.

Fourth column: Remaining Saturation of Oil, (as close as current situation as possible), in percentage.

Fifth column: Current pressure/ Minimum Miscibility Pressure ratio.

Sixth column: Porosity, in percentage.

Seventh column: Net oil thickness, in feet.

Eighth column: Dip.

Those are the variables used for the technical ranking. Immediately after the technical information, the economic variables appear as follows (in the case of the optimum reservoir fill these column with zeros):

Ninth column: Original Oil in Place, in Millions of Standard Tank Barrels.

Tenth column: Oil area, in acres.

Eleventh column: Number of active wells.

Twelfth column: Depth, in feet.

Thirteenth column: Distance to the CO_2 source in miles.

Fourteenth column: Location, put 0 for onshore reservoirs and 1 for offshore reservoirs. No specific format was used to read the INPUTdb.DAT file, because of this the order and completeness are critical. For most of the calculations, real numbers have been used, with significative figures depending on the magnitude of the variable. For guidance look at the example file attached.

The OUTPUTdb.DAT file contains the results from the model. It has three columns. The first one contains the technical ranking parameter, the second column shows the economic ranking parameter, and the third column contains the number of additional wells required to obtain the desired spacing.

RUNNING THE PROGRAM

To run the program, the user has to **open** the source code file (CO29.FOR), and input the number of reservoirs to be evaluated. In order to perform this step, the program has to be edited in the FORTRAN™ editor, DOS™ editor, or any other text editor for ASCII format. After the program is edited, go to line 5 and input the number of reservoirs to be ranked (including the optimum) plus

1, to make room for the worst reservoir parameters, which are found automatically by the computer from the data in the INPUTdb.DAT file.

Example: You want to rank 350 reservoirs, including the optimum reservoir will give 351 reservoirs, so you have to put N2=352. The number of reservoirs to be ranked, including the optimum plus the worst.

Line 5 originally: PARAMETER (M = 8, N2 = 199)

so changing 199 for 352 the line should read:

PARAMETER (M = 8, N2 = 352)

It is absolutely necessary for the INPUTdb.DAT to be complete. Once the program is run, it automatically calculates the technical ranking value. For the economic ranking part, the CO29 asks the user for the parameters used in the sensitivity analysis. These data are oil price, maximum recovery factor (15% is suggested), spacing, and CO_2 cost. Once those parameters are input in the model, it automatically calculates the correspondent economic ranking for each reservoir. At the end it asks if you want to run the program again with different values or exit.

HANDLING THE INPUTdb.DAT AND THE OUTPUTdb.DAT FILES

An easy way to prepare the input data necessary to run the program is to prepare the data in a spreadsheet, and then save it with the extension .txt. This file can be easily opened in dos™ and saved with the extension .dat.

In order to retrieve the results, the OUTPUTdb.DAT file can be saved with the extension TXT, using a conventional editor. Once in this format, the file can be imported into any spreadsheet, keeping the values in different columns. The economic part of the program can be easily programmed in a spreadsheet, and thus, sensitivity analysis results are directly accessible in the spreadsheet. Once the results are in spreadsheet form, it is possible to sort the reservoirs in order of suitability by simply using a sorting option from the spreadsheet program. Care should be taken to match the information and parameters from each reservoir with its correspondent ranking values.

ASSUMPTIONS AND LIMITATIONS OF THE ECONOMIC SCREENING

In order to rank the reservoirs, it is necessary to have a parameter that can be easily used for comparison of all of the possible candidates, and benefit/ cost ratio is suitable for this purpose. Due to the difficulty of predicting the expected performance of a reservoir without simulation, some assumptions are required to make the model work. The major assumptions are:

- The maximum expected recovery of the process is 15% of the OOIP.
- Economic evaluation uses an assumed interest rate. Evaluation considers that the project extends for only 15 years.
- Correlations used for the economic calculations of cost are estimates and depend on location.
- The desired spacing is used to calculate if additional wells need to be drilled. Spacing is a user set value which is dependent on factors such as reservoir heterogeneity, shape and size, dip, economics, and previous displacement efficiency.
- Operating costs are assumed constant, and are estimated on an annual basis.
- A gross CO_2 utilization ratio of 10 Mscf/ Bbl (6 Mscf/Bbl, net), and a value of 40% for the CO_2 recycling were used.
- The benefit-cost ratio used as an additional ranking parameter in the economic screening. It has to be higher than 0, to represent potential interest.

CO29.FOR

```
$DEBUG
* PROGRAM TO RANK RESERVOIRS FOR CO2 MISCIBLE DISPLACEMENT
      DIMENSION RES(550,14)
      INTEGER I,J,M,N1,K,N2
* "REMEMBER PUT RESERVOIR NUMBER (N1) PLUS ONE IN N2"
      PARAMETER (M = 8, N2 = 199)
      REAL OPTM(M),WRTL(M),WRTR(m),WFAC(m),WORST(m),
     & WT(m,n2),A(n2,m),X(n2,m),SUM3(n2),R(n2),NWELL(N2),
     & W(n2,m),V(n2,n2),TEMP,OPRIC,SPAC,SPACE,SPACE1,SPACE2,
     & NW(N2),COSNW,COSINJ,COSPROD,COSEQP,PIPCAP,COSPIP,COSWK,
     & OPCOS,CO2COS,TOTCOS,NREV,RATRC(n2),SMALL,PERCENT(15),
     & CO2,RF,IRATE,YEAR,BTNPV,PCOST,YREV,TWELL
      N1=N2-1
      OPEN (5,FILE='INPUTdb.DAT')
      READ (5,*) (OPTM(J),J=1,8)
      READ (5,*) (WRTR(J),J=1,8)
      READ (5,*) (WFAC(J),J=1,8)
      READ (5,*) (PERCENT(J),J=1,15)
      READ (5,*) ((RES(I,J),J=1,14),I=1,N1)
      CLOSE (5)
      OPEN (6,FILE='OUTPUTdb.DAT')
* CALCULATION OF WRTL & WORST FICTICIOUS RESERVOIR
      DO 7 J=1,8
      SMALL=1E20
      DO 8 I=2,N1
      SMALL=MIN(SMALL,RES(I,J))
 8    CONTINUE
      WRTL(J)=SMALL
      RES(N2,J)=SMALL
 7    CONTINUE
* SELECTION OF WORST PARAMETER
      DO 5,I=1,N2
      DO 10,J=1,8
      IF(RES(I,J) .GT. WRTR(J)) THEN
      RES(I,J)=WRTR(J)
      ELSE
      ENDIF
      IF(RES(I,J) .LE. OPTM(J)) THEN
       WORST(J)=WRTL(J)
      ELSE
       WORST(J)=WRTR(J)
```

```
      ENDIF
* CALCULATION OF NORMALIZED PARAMETER
      TEMP=ABS(WORST(J)-OPTM(J))
      X(I,J)=(ABS(RES(I,J)-OPTM(J))/ABS(WORST(J)-OPTM(J)))
* CALCULATION OF EXPONENTIAL FUNCTION
      A(I,J)=100*EXP(-4.6*(X(I,J)**2))
* CALCULATION OF THE WEIGTHED MATRIX
      W(I,J)=A(I,J)*WFAC(J)
 10   CONTINUE
 5    CONTINUE
* CALCULATION OF THE TRANSPOSED WEIGTHED MATRIX
      DO15,I=1,N2
      DO20,J=1,8
      WT(J,I)=W(I,J)
 20   CONTINUE
 15   CONTINUE
* CALCULATION OF THE PRODUCT MATRIX
      DO25,I=1,N2
      DO30,K=1,N2
      SUM1=0
      DO40,J=1,8
      SUM1=SUM1+W(I,J)*WT(J,K)
 40   CONTINUE
      V(I,K)=SUM1
 30   CONTINUE
 25   CONTINUE
* CALCULATION OF OPTIMUM CHARACTERISTIC PARAMETER
      I=1
      SUM2=0
      DO80,J=1,N2
      SUM2=SUM2+V(I,J)
 80   CONTINUE
      RO=SUM2
* CALCULATION OF THE CHARACTERISTIC PARAMETERS
      DO90,I=1,N2
      SUM3(I)=0
      DO100,J=1,N2
      SUM3(I)=SUM3(I)+V(I,J)
 100  CONTINUE
      R(I)=(100*SUM3(I))/RO
 90   CONTINUE
* END OF TECHNICAL RANKING - BEGINNING ECONOMIC RANKING
      PRINT *,'TECHNICAL SCREENING READY'
```

```
      PRINT *,'CONTINUE WITH ECONOMICAL SCREENING? YES=1, NO=0'
      READ *,EE
      IF (EE.EQ.0) THEN
      PRINT 1010,(R(I),I=1,N2)
      WRITE (6,1010)(R(I),I=1,N2)
      GO TO 120
      ELSE
      CONTINUE
      ENDIF
* ECONOMICAL EVALUATION
 105  PRINT *,'DISCOUNT RATE (fraction)=?'
      READ *,IRATE
      PRINT *,'OIL PRICE ($/Bbl)=?'
      READ *,OPRIC
      PRINT *,'RECOVERY FACTOR (fraction)=?'
      READ *,RF
      PRINT *,'SPACE ONSHORE (acres/well)=?'
      READ *,SPACE1
      PRINT *,'SPACE OFFSHORE (acres/well)=?'
      READ *,SPACE2
      PRINT *,'CO2 COST ($/MSCF)=?'
      READ *,CO2
* CAPITAL COSTS
* 1.DRILLING
      DO 110,I=2,N1
      IF (RES(I,14).EQ.0) THEN
      SPACE=SPACE1
      ENDIF
      IF (RES(I,14).EQ.1) THEN
      SPACE=SPACE2
      ENDIF
      IF (RES(I,11).NE.0) SPAC = (RES(I,10)/RES(I,11))
      IF (SPAC.LE.SPACE) THEN
      NW(I)=0
      ELSE
      ENDIF
      TWELL=(RES(I,10)/SPACE)
      IF (RES(I,11).GE.TWELL)THEN
      NW(I)=0
      ELSE
      NW(I)=TWELL-RES(I,11)
      ENDIF
      IF (RES(I,10).LE.60.AND.RES(I,11).EQ.0) THEN
```

```
      NW(I)=2
      ELSE
      ENDIF
      IF (RES(I,10).LE.60.AND.RES(I,11).EQ.1) THEN
      NW(I)=1
      ENDIF
      IF (RES(I,10).LE.60.AND.RES(I,11).EQ.2) THEN
      NW(I)=0
      ENDIF
      NWELL(I) = NINT(NW(I))
      IF (RES(I,14).EQ.0) THEN
      COSNW=30430*EXP(0.00035*RES(I,12))*NWELL(I)
      ENDIF
      IF (RES(I,14).EQ.1) THEN
      COSNW=688514*EXP(0.00011*RES(I,12))*NWELL(I)
      ENDIF
* 2.EQUIPMENT
      COSINJ=22892*EXP(0.00009*RES(I,12))
      COSPROD=24908*EXP(0.00014*RES(I,12))
      COSEQP=((COSINJ+COSPROD)/2)*(RES(I,11)+NWELL(I))
* 3.PIPELINE
      PIPCAP=(RES(I,9)*R(I)*RF/100)*2
      COSPIP=(100000+2008*((PIPCAP)**0.834))*RES(I,13)
*      PRINT *,COSEQP,COSPIP,COSNW
* 4.TIME DEPENDENT ECONOMICS
      PCOST = 0
      YEAR = 0
      SUM5 = 0
      DO 125 J=1,15
      YEAR =YEAR+1
* 4.1 YEARLY OIL RECOVERY
      YREC= RES(I,9)*R(I)*1.0E04*PERCENT(J)
* 4.2 OPERATION COSTS
      OPCOS=13298*EXP(0.00011*RES(I,12))*(RES(I,11)+NWELL(I))
* 4.3 CO2 PURCHASE COSTS
      CO2COS=YREC*6*CO2
* 4,4 WORKOVER COST
      COSWK=0.25*COSEQP
* 4.5 YEARLY GROSS REVENUE
      YREV=(YREC*OPRIC)/((1+IRATE)**YEAR)
* 4.6 NPV OF TIME DEPENDENT COSTS
      SUM4=(OPCOS+CO2COS+COSWK)/((1+IRATE)**YEAR)
* 4.7 BEFORE TAXES NPV OF NET INCOME
```

```
      SUM5=YREV+SUM5
      PCOST=PCOST+SUM4
 125  CONTINUE
      BTNPV=SUM5-PCOST
* 5 TOTAL COSTS
      TOTCOS=COSNW+COSEQP+COSPIP+PCOST
* 6 NET REVENUE
      NREV=BTNPV-COSNW-COSEQP-COSPIP
* 7 BENEFIT/COST RATIO
      RATRC(I)=NREV/TOTCOS
 110  CONTINUE
      PRINT 1000,(R(J),RATRC(J),NWELL(J),J=1,N2)
      WRITE (6,1000)(R(J),RATRC(J),NWELL(J),J=1,N2)
      PRINT *,'CHANGE ECONOMICAL PARAMETERS? YES=1, NO=0'
      READ *,EC
      IF (EC.EQ.1) THEN
      GO TO 105
      ELSE
      CONTINUE
      ENDIF
 1000 FORMAT (1X,F6.2,2X,F6.3,2X,F4.0)
 1010 FORMAT (1X,F6.2)
 120  END
```

INPUTDB.DAT

37	160	300	60	1.3	20	50	20							
70	250	2500	92	1.3	33	180	20							
0.24	0.14	0.07	0.2	0.19	0.02	0.1	0.03							
0.0032	0.0032	0.0092	0.0136	0.0146	0.0158	0.0162	0.0147	0.0126	0.0108	0.0094	0.0082	0.0070	0.0060	0.0055
37	160	300	60	1.3	20	50	20	0	0	0	0	0	0	
24.0	136	570.0	11.43	0.352	32.0	78	16.5	26.795	167	2	3850	24.0	1	
35.5	155	362.0	16.51	0.389	29.7	28	16.0	6.371	168	0	5132	17.0	1	
37.0	158	330.0	25.29	0.436	33.0	32	20.0	13.966	390	1	5500	41.0	1	
29.5	100	2500.0	64.17	0.393	29.0	28	6.0	2.200	47	1	8200	3.6	1	
29.5	101	2300.0	16.16	0.449	28.0	31	6.0	2.300	45	1	8067	1.4	1	
32.5	246	292.0	41.38	0.725	28.2	62	14.0	30.604	386	3	13000	53.0	1	
35.0	167	200.0	68.79	0.376	33.0	73	60.0	0.900	9	0	6400	8.1	0	
37.0	174	350.0	80.79	0.103	33.0	45	45.0	1.250	14	0	7800	9.6	0	
36.7	175	1000.0	81.99	0.495	30.0	105	60.0	1.180	8	0	7200	8.6	0	
36.0	171	200.0	64.20	0.591	33.0	83	60.0	1.800	16	0	6600	18.2	0	
40.6	160	200.0	78.26	0.235	32.0	60	40.0	0.315	4	0	6680	2.4	0	
37.5	180	200.0	48.15	0.197	30.0	85	55.0	6.300	61	0	7600	58.1	0	
34.7	206	111.0	34.47	1.247	24.5	40	30.0	17.436	473	3	10150	32.0	0	
36.1	213	100.0	44.86	0.629	28.0	29	4.5	47.000	1865	6	10000	79.0	1	
39.0	138	1900.0	17.31	1.113	30.0	44	12.0	23.310	427	2	10000	23.8	1	
36.6	162	500.0	36.69	0.692	25.2	40	8.0	35.266	1109	0	12400	41.2	1	
38.2	103	285.0	17.14	1.484	31.0	25	18.0	6.420	182	2	7900	6.0	1	
28.0	218	200.0	55.42	0.566	20.0	26	16.0	2.174	122	0	11389	5.7	0	
31.6	155	317.4	16.50	1.231	23.0	42	12.5	6.272	124	2	12700	23.9	0	
32.2	160	317.4	50.50	1.303	23.0	50	19.0	7.071	97	2	12200	39.4	0	
34.5	113	59.4	21.30	0.428	21.3	11	3.0	5.040	660	7	7500	7.9	0	
45.6	127	196.9	52.90	2.267	21.2	69	3.0	21.550	830	5	8500	69.1	0	
31.8	164	633.0	43.90	0.285	27.6	14	2.0	9.609	545	3	6365	80.5	0	
26.7	168	588.0	38.29	0.415	28.8	44	5.0	8.590	144	1	6350	49.5	0	
34.3	80	2295.0	39.04	1.471	32.9	113	45.0	3.888	19	2	4700	51.0	0	
28.0	200	500.0	34.49	0.653	30.5	8	5.0	2.952	286	0	10000	32.0	1	
38.5	151	1000.0	31.27	1.866	32.0	80	4.0	35.600	273	3	10071	59.0	1	
38.0	231	17.0	52.48	0.339	17.6	28	2.0	23.718	1883	14	11213	18.0	0	
35.0	255.5	180.0	69.96	0.533	22.0	36	5.0	13.017	473	0	13650	4.0	0	
37.5	170.5	751.0	50.10	0.491	30.5	74	15.0	5.105	54	1	8382	100.1	1	
26.0	140	915.0	33.69	0.147	30.0	17	20.0	0.938	46	0	6246	5.5	1	

30.5	162	1287.0	33.31	0.643	31.9	35	30.0	1.707	28	0	6600	17.3	1
32.0	142	250.0	25.62	0.113	29.7	48	31.0	1.481	20	0	4100	15.0	1
35.0	177	300.0	20.97	0.755	33.0	28	3.0	16.800	384	2	7850	23.9	1
36.4	206	484.0	44.53	0.794	27.6	35	2.0	27.256	788	7	10400	46.7	1
37.4	195	382.0	53.86	1.060	28.0	10	2.5	9.165	861	3	9860	18.7	1
30.1	83	250.0	40.94	0.893	29.1	10	2.0	9.023	661	5	6610	7.9	1
33.0	165	250.0	39.27	0.619	29.8	11	2.7	6.682	476	1	7150	9.4	1
35.3	98	300.0	23.93	1.402	32.6	11	2.0	7.734	440	6	7870	10.5	1
30.4	196	300.0	47.74	0.645	23.1	10	3.8	4.399	468	2	9550	4.9	1
36.0	223	200.0	56.12	0.225	22.0	18	7.3	2.000	348	2	11147	8.0	0
48.0	190	73.0	54.89	0.516	28.0	17	5.0	30.000	2277	10	8100	99.0	0
32.0	189	333.0	72.22	0.538	20.0	11	14.0	3.511	306	0	10200	77.0	0
30.0	276	75.0	57.27	0.461	22.0	41	21.0	33.459	1059	0	15000	26.3	1
30.0	276	75.0	44.39	0.496	22.0	56	21.0	41.268	976	5	15000	26.5	1
33.0	168	305.0	29.06	0.750	27.2	63	24.0	12.762	151	0	12800	14.1	1
37.0	188	789.0	49.94	1.546	30.0	18	2.5	4.768	220	1	9850	32.0	0
38.0	153	155.0	54.81	1.089	25.7	99	15.0	7.646	77	1	12250	43.5	0
37.5	232	187.0	49.63	0.224	25.8	81	17.0	7.792	48	0	12650	31.5	0
35.0	201	420.8	24.60	1.533	25.7	28	2.4	26.405	998	3	10890	28.0	0
38.0	215	30.0	34.19	0.857	19.0	22	1.5	30.000	3124	18	9960	0.0	0
38.3	202	65.0	44.91	0.588	23.2	7	1.0	6.245	1266	0	9800	18.0	0
41.0	215	40.0	40.89	1.333	20.0	26	1.5	46.000	3398	0	10100	6.0	0
29.0	151	500.0	20.38	0.579	34.0	19	0.5	20.420	640	0	6640	51.0	1
31.0	101	1000.0	20.75	1.078	30.0	44	5.0	29.000	486	3	8100	48.0	1
33.0	94	500.0	56.65	0.741	30.0	15	2.0	5.850	277	0	7500	16.3	1
35.2	120	500.0	39.86	0.760	30.0	33	5.0	2.534	103	3	7730	7.5	1
28.0	170	500.0	31.06	0.548	32.5	16	4.0	10.030	465	7	7450	14.8	1
29.0	174	500.0	46.85	0.666	32.0	15	4.0	11.000	550	6	7900	24.5	1
36.0	182	300.0	35.05	0.469	32.0	15	4.0	9.203	397	4	8450	27.0	1
33.8	191	300.0	63.58	0.894	28.0	27	6.0	4.227	129	4	10630	32.0	0
47.4	80	591.0	14.85	4.587	28.0	6	1.6	2.129	387	5	9650	6.0	0
36.5	198	300.0	57.00	0.904	27.2	21	9.5	9.286	416	2	11425	1.0	0
35.7	193	515.0	62.00	0.909	28.8	45	8.0	13.453	235	6	10450	1.0	0
36.8	205	1910.0	51.70	0.752	27.5	51	10.0	11.723	114	2	10300	1.0	0
38.0	200	1348.0	60.00	0.872	26.2	55	4.0	119.02	2057	8	10000	1.0	0
33.5	181	200.0	62.76	0.892	31.3	9	5.0	11.547	1096	5	10000	59.0	0

28.1	142	300.0	48.42	0.642	26.0	22	26.0	1.794	69	0	9250	13.0	0
32.1	157	277.0	56.48	0.135	29.2	18	17.0	2.054	89	0	10200	21.0	0
39.0	123	1173.0	64.37	0.120	31.0	30	50.0	3.200	74	3	5886	41.0	0
33.2	80	220.0	50.75	1.999	27.4	25	4.0	17.256	635	1	8200	38.1	1
27.2	185	375.0	48.90	0.551	30.0	9	0.0	6.014	615	0	8540	8.4	1
34.5	112	1669.0	22.12	1.102	32.0	28	3.0	16.954	303	3	8950	29.0	1
34.7	190	500.0	22.12	0.565	30.0	13	3.0	2.941	179	0	9406	5.0	1
35.8	118	400.0	46.77	1.053	28.0	22	5.0	7.874	332	1	9450	20.1	1
35.9	200	200.0	31.95	0.946	28.0	20	2.0	3.100	90	1	9430	6.4	1
32.0	251	30.0	67.03	0.634	18.0	15	10.0	4.300	360	4	13250	32.0	0
47.0	83	400.0	29.04	3.805	29.0	20	5.0	1.575	100	3	10050	8.0	0
47.0	198	40.0	26.25	1.127	25.2	26	6.0	2.876	411	0	10225	24.0	0
32.0	104	325.0	43.20	0.819	31.8	45	2.0	84.298	1456	9	8294	24.2	1
30.3	177	500.0	43.19	0.638	27.8	36	3.0	44.700	1284	4	8472	12.6	1
32.4	179	500.0	35.66	0.734	31.0	43	1.7	85.250	1496	7	8721	26.5	1
29.4	164	338.0	38.77	0.437	29.8	18	4.0	26.546	1135	5	7275	6.1	1
33.0	180	100.0	45.32	0.492	29.5	14	3.0	19.227	1014	29	8600	6.1	1
30.0	178	447.0	61.02	0.341	26.0	39	3.0	36.700	960	12	8295	11.6	1
26.0	172	300.0	28.11	0.281	32.0	18	2.0	9.070	374	2	8020	1.3	1
28.9	167	400.0	22.58	0.662	32.0	23	7.0	37.500	1182	11	8725	6.8	1
32.0	182	200.0	40.87	0.746	31.0	6	2.5	4.700	702	0	8485	1.4	1
35.0	184	400.0	34.51	0.371	30.6	13	1.5	5.370	374	3	9025	1.8	1
36.0	184	400.0	15.26	0.744	31.0	20	1.5	12.700	528	3	9200	4.1	1
35.0	200	200.0	68.01	0.832	30.0	10	13.0	2.140	242	1	10150	0.8	1
39.0	186	200.0	27.46	0.649	30.0	30	5.0	4.100	330	0	9450	1.3	1
34.2	111	100.0	22.88	1.103	31.0	9	1.0	3.096	295	0	8900	0.8	1
32.0	176	500.0	42.19	0.362	29.0	24	3.0	14.600	577	11	8150	4.3	1
26.0	164	200.0	37.31	0.260	30.0	8	2.0	3.286	378	1	7350	0.6	1
30.0	89	200.0	38.31	0.579	29.0	6	1.4	2.500	333	4	7100	0.4	1
25.0	166	500.0	57.17	0.262	32.0	22	1.3	5.378	166	1	7750	1.4	1
25.0	153	200.0	27.95	0.277	34.0	15	1.0	19.250	870	10	6650	2.5	1
31.1	163	200.0	26.21	0.323	31.8	13	2.5	12.717	804	6	7550	2.6	1
35.0	167	300.0	24.26	0.555	30.0	15	1.5	44.159	1574	18	7860	14.3	1
30.0	106	300.0	19.98	0.382	32.0	43	2.0	27.800	460	18	8450	3.5	1
30.0	175	300.0	32.26	0.725	32.0	23	2.0	12.300	374	7	8700	2.8	1
39.5	186	500.0	21.46	1.161	32.0	24	2.0	17.000	516	5	8125	6.4	1

32.0	167	400.0	39.85	0.754	31.0	30	2.0	35.900	1028	3	9530	11.6	1
36.0	184	600.0	32.09	0.452	31.0	12	2.0	10.900	762	0	9050	3.6	1
33.0	187	200.0	38.91	0.409	30.7	13	2.0	9.365	714	2	8750	2.6	1
32.4	178	200.0	47.52	0.465	30.0	40	9.0	7.440	150	3	7500	3.9	1
32.8	175	500.0	36.18	0.328	32.0	24	5.5	1.380	37	3	7450	0.6	1
29.5	162	400.0	57.45	0.574	33.0	39	2.5	39.000	691	6	6775	19.7	1
25.0	155	500.0	14.43	0.463	33.0	32	4.0	8.860	142	5	6280	1.8	1
31.5	170	1000.0	31.59	0.401	32.0	26	7.0	6.079	170	1	7500	2.2	1
27.0	159	600.0	33.89	0.479	33.0	41	4.0	22.920	360	9	6750	6.8	1
26.8	168	300.0	48.84	0.521	33.0	19	1.5	10.720	359	0	7500	4.1	1
32.0	168	300.0	44.83	0.420	33.0	17	4.5	10.419	381	2	7400	5.1	1
27.0	161	300.0	26.33	0.490	32.9	10	2.5	3.706	273	3	7300	0.9	1
26.0	160	200.0	21.86	0.480	33.0	11	2.5	9.570	557	9	7000	1.9	1
27.0	165	550.0	50.19	0.407	31.0	26	7.0	2.755	65	0	7250	1.1	1
26.8	168	300.0	38.75	0.432	33.0	26	1.5	10.077	270	0	7520	3.1	1
32.0	168	300.0	36.93	0.340	33.0	27	4.5	14.387	328	6	7350	6.2	1
27.0	161	300.0	28.42	0.438	33.0	21	2.5	6.238	201	1	7450	1.5	1
26.0	160	500.0	31.54	0.391	33.0	22	2.5	21.170	529	6	7000	5.3	1
26.8	168	300.0	26.69	0.329	33.0	22	1.5	3.458	116	1	7550	0.8	1
32.0	168	300.0	22.94	0.616	33.0	28	4.5	9.173	211	3	7450	3.5	1
27.0	161	300.0	28.96	0.444	33.0	24	2.5	3.589	102	1	7350	0.9	1
28.0	165	537.0	43.45	0.478	30.0	35	7.0	3.692	70	1	7300	1.4	1
26.0	160	500.0	44.78	0.279	33.0	33	2.5	25.320	434	3	7000	8.9	1
26.0	160	200.0	22.28	0.451	33.0	23	2.5	10.480	347	5	7000	2.1	1
27.0	94	380.0	41.39	0.667	29.0	18	6.0	2.400	119	1	7500	0.5	1
27.0	171	144.0	45.92	0.188	29.0	12	8.0	0.879	69	0	7600	0.3	1
24.2	168	400.0	29.31	0.444	31.5	20	2.5	54.170	1765	14	7800	12.3	1
27.5	170	400.0	39.21	0.441	31.0	24	9.0	3.120	77	3	7700	1.0	1
36.0	190	700.0	39.55	0.699	31.0	26	7.5	8.433	208	1	8650	4.9	1
24.2	168	400.0	8.01	0.752	31.0	20	2.5	2.840	136	3	7800	0.6	1
24.2	168	400.0	23.11	0.511	32.0	28	2.5	16.610	466	3	7800	3.6	1
24.2	168	400.0	30.28	0.431	31.0	8	2.5	4.910	593	0	7875	1.1	1
26.6	172	400.0	48.83	0.312	30.0	34	5.0	7.444	157	3	7600	2.8	1
24.2	168	400.0	22.71	0.237	31.0	35	2.5	10.890	302	4	7850	2.3	1
26.8	168	300.0	39.07	0.405	33.0	12	1.5	5.236	367	1	7470	1.6	1
32.0	168	300.0	35.91	0.364	32.2	11	4.5	3.441	276	1	7550	1.4	1

27.0	161	300.0	34.66	0.361	31.7	10	2.5	5.132	393	0	7650	1.4	1
26.0	160	100.0	31.39	0.401	33.0	8	2.5	5.980	675	3	7000	1.3	1
35.0	188	700.0	62.31	0.104	32.0	17	7.5	3.614	134	0	8100	2.2	1
30.0	190	500.0	69.37	0.234	31.0	26	6.0	1.209	36	0	8650	0.4	1
35.0	191	500.0	51.47	0.731	31.0	16	6.0	1.903	102	0	8750	1.2	1
31.0	191	500.0	40.07	0.458	31.0	13	6.0	0.458	27	0	8750	0.2	1
32.0	177	300.0	44.85	0.696	30.0	25	7.5	0.985	53	2	8100	0.5	1
27.5	160	500.0	54.36	0.484	28.0	17	10.0	4.080	174	2	6200	1.7	1
27.5	160	500.0	24.51	0.765	32.0	13	6.0	1.038	54	2	6300	0.3	1
32.0	175	500.0	58.10	0.371	32.0	11	7.0	2.888	181	5	7530	1.6	1
31.0	191	500.0	53.06	0.656	31.0	11	10.0	0.228	18	0	8660	0.1	1
25.6	153	500.0	20.11	0.324	33.4	33	3.0	30.180	992	18	6420	6.3	1
29.0	165	500.0	54.06	0.418	33.0	7	7.5	1.152	120	1	7350	0.5	1
31.0	80	300.0	57.62	1.152	30.0	14	3.0	2.589	158	1	7200	1.3	1
32.0	93	300.0	43.91	0.569	32.0	16	7.5	2.240	120	2	7430	0.8	1
37.3	172	1329.0	60.93	0.598	30.2	15	2.7	11.596	541	5	7665	58.5	1
33.9	178	1368.0	38.84	0.791	29.6	34	3.5	22.404	430	4	8040	87.5	1
38.5	154	3485.0	49.72	0.671	31.6	18	5.0	47.848	1500	9	8300	37.0	0
32.1	211	180.0	31.33	0.980	25.5	39	8.0	2.412	60	0	11400	6.1	1
33.0	106	400.0	31.33	1.013	29.0	35	14.5	2.696	58	0	8450	7.7	1
32.5	112	245.0	46.87	0.678	28.0	38	12.0	20.175	501	1	8987	62.5	1
29.0	175	300.0	56.01	0.272	26.0	30	10.0	1.604	41	0	6850	4.7	1
37.0	104	39.6	61.97	0.583	30.9	25	33.0	4.169	112	0	8300	25.9	0
39.5	103	373.0	53.04	0.485	32.9	30	33.0	3.948	80	0	8276	25.1	0
37.0	205	316.0	34.76	0.758	28.0	7	4.0	3.170	429	5	10800	38.7	0
32.0	185	66.0	64.47	0.389	23.2	10	5.0	2.420	224	2	8030	21.3	0
32.3	185	66.0	62.72	0.666	24.6	7	5.0	1.430	168	1	8000	13.9	0
37.4	185	38.0	57.13	0.731	28.5	5	5.0	2.516	448	2	7833	31.8	0
30.0	136	500.0	47.26	1.163	30.0	55	3.0	26.200	436	2	10850	19.7	1
30.0	80	100.0	56.45	0.620	32.4	14	6.0	2.629	153	1	6300	1.3	1
36.9	166	500.0	39.93	0.256	32.9	29	9.0	1.203	29	1	7270	1.1	1
33.0	104	500.0	39.07	0.774	31.5	23	8.0	2.592	74	1	7000	1.6	1
34.0	115	228.0	54.48	0.789	28.4	23	3.2	29.041	1032	0	9235	24.1	1
35.0	182	380.0	82.00	0.590	30.6	12	1.4	18.689	1461	0	9100	12.7	1
31.3	80	470.0	38.43	1.306	32.6	41	4.5	49.700	530	5	7419	29.9	1
30.0	80	500.0	32.21	1.054	34.0	14	3.0	12.800	547	2	6180	5.2	1

33.4	101	500.0	57.94	0.465	30.0	52	4.6	4.439	59	0	8070	3.4	1
31.2	212	579.0	60.80	0.816	29.9	11	4.3	1.867	141	0	10280	1.3	1
27.2	206	594.0	29.74	0.722	30.8	21	4.1	18.269	683	0	10473	5.0	1
27.8	212	719.0	59.11	0.211	29.7	14	3.6	13.110	724	1	10289	6.0	1
28.4	208	636.0	48.51	0.156	30.6	13	3.3	3.672	225	1	10393	1.5	1
28.5	192	1180.0	60.80	0.665	29.1	21	3.3	13.280	466	5	9490	7.5	1
28.0	207	400.0	57.66	0.426	28.0	16	6.0	2.542	131	0	9841	1.3	1
30.0	220	400.0	35.41	0.509	29.0	25	5.0	9.034	290	2	9133	3.2	1
31.8	170	500.0	35.41	0.987	33.0	30	4.3	1.875	40	0	7100	1.3	1
33.3	128	600.0	56.22	0.354	30.4	16	23.0	1.447	57	0	8500	0.3	1
33.8	108	1200.0	36.45	1.495	33.0	84	27.0	6.960	40	1	8600	1.2	1
30.9	126	1058.0	58.07	0.827	29.0	31	31.0	2.232	54	0	8400	0.4	1
32.0	128	305.0	40.09	0.671	29.0	78	20.0	4.433	27	0	8500	0.7	1
33.1	116	400.0	44.10	1.314	28.0	42	20.0	4.651	75	0	7700	0.9	1
30.3	180	64.0	44.10	0.186	25.0	24	22.0	3.932	146	0	12011	0.5	1
32.0	124	360.0	40.09	1.326	26.0	39	16.0	0.894	19	0	8278	0.2	1
35.5	196	200.0	40.44	0.611	28.0	20	2.0	60.505	2417	0	10100	83.0	1
27.4	154	212.0	46.37	0.335	29.6	43	64.0	2.208	36	0	6500	23.3	0
28.1	176	800.0	29.00	0.303	28.4	100	55.0	10.982	87	0	7875	75.7	0
37.0	160	200.0	59.00	0.458	26.0	7	5.0	13.380	3040	12	7050	24.3	1
37.0	160	200.0	46.87	0.548	26.0	7	5.0	13.380	3040	23	7050	22.7	1
30.0	109	200.0	16.78	0.286	30.0	175	53.0	0.500	2	0	5000	8.0	0

OUTPUTDB.DAT

100.00	.000	0.
18.99	.830	0.
57.16	-.046	2.
62.80	.000	4.
35.34	-.623	1.
13.45	-.829	1.
49.04	.211	2.
72.81	-.556	2.
62.45	-.595	2.
59.28	-.585	2.
82.01	-.374	2.
62.52	-.814	2.
74.86	-.211	2.
62.66	-.243	9.
61.75	-.314	17.
64.42	.521	3.
73.43	-.341	14.
58.62	1.593	0.
37.46	-.839	3.
53.86	-.362	1.
79.11	.253	0.
37.73	-.752	10.
77.31	-.157	16.
53.55	-.556	11.
36.77	-.417	3.
58.15	-.477	0.
26.45	-.917	4.
76.50	1.867	0.
63.12	-.732	33.
56.46	-.805	12.
81.52	-.566	1.
24.26	-.917	2.
41.96	-.810	2.
42.10	-.792	2.
58.60	.255	3.
70.91	.367	3.
84.34	-.553	8.
36.22	-.427	3.
57.86	-.511	5.

56.17	.547	0.
46.34	-.743	4.
65.92	-.884	7.
58.14	-.577	47.
47.93	-.883	8.
40.74	-.690	13.
33.25	-.514	7.
56.94	.052	2.
85.71	-.494	5.
91.19	.064	1.
64.99	-.321	2.
61.32	-.528	22.
55.81	-.754	60.
62.56	-.880	32.
66.01	-.676	85.
29.43	-.581	8.
35.22	.014	3.
59.36	-.390	3.
63.15	.091	0.
30.97	.004	0.
47.13	-.032	1.
62.21	.081	1.
74.57	-.225	0.
42.22	-.864	5.
81.95	-.462	8.
85.04	2.148	0.
74.25	1.845	1.
81.73	.615	43.
73.46	-.712	22.
45.29	-.699	2.
64.18	-.657	2.
69.68	-.418	0.
65.17	-.243	7.
40.67	-.812	8.
50.43	.486	1.
49.90	-.622	2.
75.17	-.221	3.
60.63	.856	0.
43.20	-.895	5.
48.13	-.524	0.
48.14	-.891	10.
50.98	.821	9.
49.54	-.041	12.

54.95	.605	12.
40.30	-.280	9.
55.83	.134	0.
55.79	1.998	0.
24.80	-.564	3.
31.79	.061	4.
51.38	-.826	9.
57.67	-.321	2.
57.39	-.157	4.
67.93	-.651	2.
58.25	-.663	4.
47.59	-.774	4.
52.39	.862	0.
29.68	-.828	4.
26.83	-.324	0.
45.94	.195	1.
22.65	.067	1.
35.96	-.399	4.
57.34	1.143	2.
22.20	.083	0.
39.59	.785	0.
66.09	1.365	1.
57.22	-.044	10.
58.96	-.624	10.
49.45	-.619	7.
60.03	1.779	0.
51.41	-.137	0.
58.15	1.323	3.
23.60	.476	0.
41.57	.210	1.
34.24	1.239	0.
44.05	-.255	4.
56.22	.039	3.
27.08	.148	0.
22.46	-.095	0.
45.18	-.203	1.
35.06	-.258	3.
49.67	1.531	0.
28.14	-.460	2.
28.49	.583	1.
26.03	1.170	0.
44.22	1.678	0.
28.74	1.367	0.

42.99	1.883	0.
40.31	.922	2.
23.00	.536	0.
25.98	.770	0.
36.12	-.777	1.
26.02	-.186	8.
36.03	.209	0.
66.65	.258	2.
25.03	-.163	0.
24.76	-.280	3.
26.02	-.873	7.
43.61	1.390	0.
24.22	.770	0.
34.21	-.698	4.
47.87	-.495	2.
31.12	-.776	5.
24.04	-.803	5.
72.01	-.234	2.
41.66	-.840	2.
73.84	-.231	1.
41.36	-.939	2.
58.33	-.050	0.
48.61	1.483	0.
30.85	-.308	0.
62.53	.193	0.
54.23	-.960	2.
24.01	.417	0.
50.73	-.648	1.
56.99	-.190	1.
43.09	.494	0.
80.83	-.021	2.
62.46	.271	1.
76.76	.259	29.
43.93	-.775	2.
49.63	-.640	2.
54.06	-.243	5.
51.13	-.722	2.
67.79	-.327	3.
69.06	-.216	2.
60.14	-.846	6.
53.90	-.716	4.
59.58	-.728	3.
77.64	-.761	9.

60.26	.538	3.
38.90	-.365	1.
70.53	-.509	1.
48.39	1.463	0.
66.82	-.247	13.
54.49	-.674	18.
48.52	1.514	2.
32.60	-.417	5.
62.53	-.207	2.
54.37	-.739	2.
21.94	-.774	9.
36.86	-.699	8.
33.86	-.711	2.
45.59	.340	1.
39.69	-.728	2.
28.07	-.418	2.
56.74	-.621	2.
63.05	-.710	2.
59.13	.679	1.
56.78	-.600	2.
50.72	-.332	2.
66.76	.650	1.
41.01	-.656	2.
59.13	-.824	2.
61.23	-.436	30.
43.58	-.633	2.
28.43	-.558	2.
81.36	-.722	26.
75.68	-.628	15.
16.41	-.930	2.
1.01	.000	0.

APPENDIX C

List of the Ranked 197 Louisiana Waterflooded Reservoirs

Base Case: 197 reservoirs with complete information

operator	b-codes	field	reservoir	ID #	API	Temp (f)	Perm md	So %	P/MMP	poro. %	net pay feet	Dip deg	EOOIP MMBbl	area oil acres	wells present	depth feet	Dist miles
Chevron	B-0264	Bay Marchand Blk 2	3650' Upper Block D, 3650' (U) RD Sand	6	24	136	570.0	86	0.352	32.0	78	16.5	26.795	167	6	3850	87
Chevron	B-0406	Bay Marchand Blk 2	4400' "G"	7	35.5	155	362.0	65	0.389	29.7	28	16	6.371	168	0	5132	87
Chevron	B-0040	Bay Marchand Blk 2	4600 A-B Sand	8	37	158	330.0	43	0.436	33.0	32	20	13.966	390	10	5500	87
Chevron	B-0483	Bay Marchand Blk 2	8350 "NN"	11	29.5	100	2500.0	77.5	0.393	29.0	28	6	2.200	47	3	8200	87
Chevron	B-0484	Bay Marchand Blk 2	8400' "NN"	12	29.5	101	2300.0	77.5	0.449	28.0	31	6	2.300	45	2	8067	87
Texaco	B-0192	Bay St. Elaine	13600 - Ft. Sand, Seg. C & C-1	14	32.5	246	292.0	52	0.725	28.2	62	14	30.604	386	5	13000	61
Shell	B-0349	Black Bayou	"T" Sand Reservoir "M"	29	35	167	200.0	61	0.376	33.0	73	60	0.900	9	1	6400	105
Shell	B-0394	Black Bayou	"T" Sand	30	37	174	350.0	65	0.103	33.0	45	45	1.250	14	0	7800	105
Shell	B-0379	Black Bayou	"T" Sand Reservoir O	31	36.7	175	1000.0	65	0.495	30.0	105	60	1.160	8	0	7200	105
Shell	B-0350	Black Bayou	"T2" Sand, Reservoir "F"	32	36	171	200.0	57	0.591	33.0	83	65	1.800	16	1	6600	105
Shell	B-0439	Black Bayou	BB O RF SU	35	40.6	160	200.0	68.9	0.235	32.0	60	40	0.315	4	1	6680	105
Shell	B-0330	Black Bayou	Frio Sand, reservoir A	38	37.5	180	200.0	36	0.197	30.0	85	55	6.300	61	3	7600	105
Exxon	B-0409	Bully Camp	Textularia, RL	44	34.7	206	111.0	59	1.247	24.5	40	30	17.436	473	4	10150	61
Chevron	B-0265	Burrwood	"T" Res A	45	36.1	213	100.0	43	0.629	28.0	29	4.5	47.000	1865	16	10000	130
Texaco	B-0334	Caillou Island	9400 ft Sand, RBB1C	66	39	138	1900.0	17.3	1.113	30.0	44	12	23.310	427	2	10000	71
Texaco		Caillou Island	Caillou Island 53-C RA SU	68	36.6	162	200.0	36.69	0.692	25.2	40	8	35.266	1109	5	12400	71
Texaco	B-0308	Caillou Island	Upper 8000 RA SU	75	38.2	103	285.0	17.14	1.484	31.0	25	18	6.420	182	2	7900	71
Superior	B-0149	Clovelly	No. 37 Sand Fault Block VII	84	28	218	200.0	50.4	0.566	20.0	26	16	2.174	122	1	11389	69
Superior Oil Co.	B-0059	Clovelly	No. 50 Sand, Fault Block VI	85	31.6	155	317.4	70.34	1.231	23.0	42	12.5	6.272	124	5	12700	69
Superior Oil Co.	B-0058	Clovelly	No. 50 Sand, Fault Block VII	86	32.2	160	317.4	59.7	1.303	23.0	50	19	7.071	97	2	12200	69
Atlantic Refinin	B-0060	Dave Haas	Sparta	92	34.5	113	59.4	37.5	0.428	21.3	11	3	5.040	660	4	7500	77
Atlantic Refinin	B-0003	Dave Haas	Wilcox Sand	93	45.6	127	196.9	49	2.267	21.2	69	3	21.550	830	11	8500	77
Texaco	B-0311	Delta Duck Club	Lower 6300' Sand, Seg A	97	31.8	164	633.0	46.9	0.285	27.6	14	2	9.609	545	5	6365	130
Texaco	B-0166	Delta Duck Club	Lower 6300' Sand, Seg. B	98	26.7	168	588.0	67.2	0.415	28.8	44	5	8.590	144	3	6350	130
Texaco	B-0220	Dog Lake	DGL CC RU SU (Revision)	109	34.3	80	2295.0	22.2	1.471	32.9	113	45	3.886	19	3	4700	53
Shell	B-0352	Eugene Island Block	P' RB SU	138	28	200	500.0	35.9	0.653	30.5	8	5	2.952	286	3	10000	32
Shell	B-0105	Eugene Island Block	"O" Sand	139	38.5	151	1000.0	82	1.866	32.0	80	4	35.600	273	7	10071	30
American Tradl	B-0491	Frisco	Upper Wilcox Zone Reservoir A	140	38	231	17.0	52	0.339	17.6	28	2	23.718	1883	14	11213	40
Quintana Petrol	B-0397	Garden City	13600' Operc. 9 Sand	141	35	255.5	180.0	70	0.533	22.0	36	5	13.017	473	5	13650	4
Texaco	B-0384	Garden Island Bay	189 RB SU	144	37.5	170.5	751.0	41.75	0.491	30.5	74	15	5.105	54	1	8382	138
Texaco	B-0445	Garden Island Bay	248-B Sand, Seg D-1	145	26	140	915.0	37.9	0.147	30.0	17	20	0.938	46	1	6246	138
Texaco	B-0382	Garden Island Bay	G-1 Sand, Seg C-2	151	30.5	162	1287.0	43.9	0.643	31.9	35	30	1.707	28	1	6600	138
Texaco	B-0446	Garden Island Bay	G-2 Sand, Segment H-4	152	32	142	250.0	41.5	0.113	29.7	48	31	1.481	20	0	4100	138
Gulf	B-0320	Grand Bay	10B Sand, Fault Block "A-1"	154	35	177	300.0	47	0.755	33.0	28	3	16.800	384	7	7850	122
Gulf	B-0078	Grand Bay	21 Sand, Fault Block "B"	156	36.4	206	484.0	64.6	0.794	27.6	35	2	27.256	788	23	10400	122
Gulf	B-0077	Grand Bay	31 Marker Sand, Fault Block "A"	157	37.4	195	382.0	62.4	1.06	28.0	10	2.3	9.165	861	14	9860	122
Gulf	B-0340	Grand Bay	4 sd. Fault Block "C"	158	30.1	83	250.0	59.4	0.893	29.1	10	2	9.023	661	6	6610	122
Gulf	B-0200	Grand Bay	6-B Sand, Fault Block "C", Res. "A"	159	33	165	250.0	47	0.619	29.8	11	2.7	6.682	476	5	7150	122
Gulf	B-0229	Grand Bay	GB 10B (FBB) RA SU	160	35.3	98	300.0	35.4	1.402	32.6	11	3.2	7.734	440	11	7870	122
Gulf	B-0341	Grand Bay	20 Sand , Fault Block "A"	161	30.4	198	300.0	55.3	0.645	23.1	10	3.8	4.399	466	5	9550	122
Concord Operat	B-0507	Hester	D3 RC SU	171	36	223	200.0	43	0.225	22.0	18	7.3	2.000	346	2	11147	22
Socony Mobil O	B-0108	Hurricane Creek	Doornbos Sand	173	48	190	73.0	40	0.516	28.0	17	5	30.000	2277	17	8100	99
Texaco	B-0499	Lafitte	Lwr. St. Dennis Sd., Seg H	180	32	189	333.0	0.48	0.538	0.2	11	14	3.511	306	6	10200	77
Texaco	B-0126	Lake Barre	LB LM1 SU	181	30	276	75.0	68	0.461	22.0	41	21	33.459	1059	9	15000	67
Texaco	B-0127	Lake Barre	LB LM2 SU	182	30	276	75.0	64	0.496	22.0	56	21	41.268	976	13	15000	67
Texaco		Lake Barre	Unit B Upper M-1 Sand	193	33	168	305.0	79	0.75	27.2	63	23	12.762	151	3	12800	67
Union	B-0230	Lake Hatch	9850 ft	201	37	188	789.0	75	1.546	30.0	18	2.5	4.768	220	3	9850	36
Texaco	B-0413	Leeville	95 Sand, Seg B	219	38	153	155.0	57.2	1.089	25.7	99	15	7.646	77	4	12250	75
Texaco	B-0414	Leeville	96 Sand, Seg B	221	37.5	232	187.0	50.2	0.224	25.8	81	17	7.792	48	6	12650	75
Humble	B-0083	Little Lake	E-4 Sand, Res. A	226	35	201	420.8	72	1.533	25.7	28	3	26.405	998	25	10890	65
Amoco	B-0480	Livingston	LVG WX 1 RA SU	231	38	215	30.0	43	0.857	19.0	22	1.5	30.000	3124	18	9960	0
Sun	B-0236	Livonia	Cockfield	232	38.3	202	65.0	53.9	0.588	23.2	7	1	6.245	1266	12	9800	37

Amoco	B-0475	Lockhart Crossing	LKHT 1 st WX RA SU	233	41	215	40.0	53	1.333	20.0	26	1.5	46.000	3398	29	10100	6
Shell	B-0323	Main Pass Block 35	"G2" Reservoir A Sand Unit	236	29	151	500.0	47	0.579	34.0	19	0.5	20.420	640	16	6640	110
Chevron	B-0049	Main Pass Block 69	8150 B-C Sand	244	31	101	1000.0	48.9	1.078	30.0	44	5	29.000	486	22	8100	138.1
Chevron	B-0388	Main Pass Block 69	8400' Sand- Reservoir C	245	33	94	500.0	57	0.741	30.0	15	2	5.850	277	5	7500	138.1
Shell	B-0458	Main Pass Block 69	"bQ" Resrvoir A Sand Unit	246	35.2	120	200.0	38	76	30.0	33	5	2.534	103	3	7730	138.1
Shell	B-0084	Main Pass Block 69	Res. A, "Q" Sand	248	28	170	500.0	65	0.548	32.5	16	4	10.030	465	10	7450	138.1
Shell	B-0138	Main Pass Block 69	Reservoir B "Q2" Sand	249	29	174	500.0	65	0.666	32.0	15	4	11.000	550	9	7900	138.1
Shell	B-0472	Main Pass Block 69	T1 Reservoir B Sand Unit	250	36	182	200.0	35.05	0.469	32.0	15	4	9.203	397	6	8450	138.1
Louisiana Land	B-0506	Manila Village	29 Sand	252	33.8	191	300.0	75	4.587	28.0	27	6	4.227	129	3	10630	79
DeNovo Oil & G	B-0500	North Burtville	9650' Reservoir A	261	47.4	80	591.0	14.85	0.904	28.0	6	1.6	2.129	387	4	9650	10
Texaco		Paradis	10000 ft Sand, Reservoir M	274	36.5	211	300.0	73	0.909	27.2	21	9.5	9.286	416	12	11425	45
Texaco		Paradis	Lower 9000 Ft Sand RM	275	35.7	193	515.0	80.5	0.752	28.8	45	8	13.453	235	6	10450	45
Texaco		Paradis	Main Pay Sand, Seg. T	276	36.8	80	2440.0	51.7	0.872	27.5	74	10	11.040	114	3	10260	45
Texaco		Paradis	Paradis Zone, Seg A-B	277	38	185	1348.0	60	0.892	26.2	55	4	119.021	2057	60	10000	45
Charles B. Wrig	B-0371	Perry Point	Third Alliance (Miocene)	279	33.5	181	200.0	28	0.642	31.3	9	5	11.547	1096	21	10000	34
Texaco	B-0177	Plumb Bob	10300 ft Sd- Seg. D	283	28.1	142	300.0	73	0.135	26.0	22	26	1.794	69	1	9250	34
Texaco		Plumb Bob	10300' Sand R-I	284	32.1	157	277.0	45.7	0.12	29.2	18	17	2.054	89	2	10200	34
Energy Service	B-0343	Port Barre	Futral Sand, Res A	285	39	123	1173.0	64.37	1.999	31.0	30	50	3.200	74	3	5886	55
Gulf	B-0454	Quarantine Bay	3 sand, Reservoir B	291	33.2	80	220.0	51	0.551	27.4	25	4	17.256	635	5	8200	107
Gulf	B-0389	Quarantine Bay	5 Sand, (REF)	292	27.2	185	375.0	53	1.102	30.0	9	0	6.014	615	5	8540	107
Gulf	B-0178	Quarantine Bay	8 Sand, Reservoir "B"	293	34.5	112	1669.0	49.1	0.565	32.0	28	3	16.954	303	15	8950	107
Gulf		Quarantine Bay	8F Sand Fault Block "B"	294	34.7	190	500.0	70	1.053	30.0	13	3	2.941	179	5	9406	107
Gulf	B-0153	Quarantine Bay	9A Sand, Fault Block "C"	295	35.8	118	400.0	51.8	0.946	28.0	22	5	7.874	332	9	9450	107
Gulf	B-0390	Quarantine Bay	9BC, C2	296	35.9	200	200.0	48.1	0.634	28.0	20	2	3.100	90	2	9430	107
Amoco	B-0489	Section 28	2nd Hackberry-Reservoir D	310	32	251	30.0	45	3.805	18.0	15	10	4.300	360	3	13250	37
DeNovo Oil & G	B-0481	Siegen	NS-3	317	47	83	400.0	29.04	1.127	29.0	20	5	1.575	100	4	10050	12
Amoco		South Black Bayou	Camerina B	321	47	198	40.0	43	0.819	25.2	26	6	2.876	411	4	10225	109
Chevron	B-0030	South Pass Block 24	8200' "T" Sand	322	32	104	325.0	67.8	0.638	31.8	45	2	84.298	1456	21	8294	162
Chevron	B-0324	South Pass Block 24	8400 RA Sand Unit	323	30.3	177	500.0	34.1	0.734	27.8	36	3	44.700	1284	55	8472	162
Chevron	B-0246	South Pass Block 24	8600' RA Sand Unit	324	32.4	179	500.0	48	0.437	31.0	43	1.7	85.250	1496	49	8721	162
Gulf	B-0244	South Pass Block 24	4-Sand, Fault Block B	325	29.4	164	338.0	62	0.492	29.8	18	4	26.546	1135	28	7275	162
Gulf	B-0419	South Pass Block 24	8 Sand, Reservoir B	326	33	180	100.0	0.56	0.341	0.3	14	3	19.227	1014	22	8600	162
Hassie Hunt Tr	B-0247	South Pass Block 24	8800' RD	327	30	178	447.0	42.7	0.281	26.0	39	3	36.700	960	34	8295	162
Shell	B-0357	South Pass Block 24	"Q" RE SU	329	26	172	300.0	35	0.662	32.0	18	2	9.070	374	4	8020	162
Shell	B-0282	South Pass Block 24	"Q" Sand Reservoir "C"	330	28.9	167	400.0	47.6	0.746	32.0	23	7	37.500	1182	37	8725	162
Shell	B-0156	South Pass Block 24	"R2" Reservoir A Sand Unit	331	32	182	200.0	44	0.371	31.0	6	2.5	4.700	702	5	8485	162
Shell	B-0091	South Pass Block 24	"S" Sand (Proposed Unit "A")	332	35	184	400.0	62	0.744	30.6	13	1.5	5.370	374	7	9025	162
Shell	B-0092	South Pass Block 24	"T" Sand (Proposed Unit "A")	333	36	184	400.0	68.7	0.832	31.0	20	1.5	12.700	528	12	9200	162
Shell	B-0095	South Pass Block 24	"T1" Sand (Proposed Unit "B")	335	35	200	200.0	70	0.649	30.0	10	13	2.140	242	3	10150	162
Shell		South Pass Block 24	"T1" Sand, F-1 down.	336	39	186	200.0	27.46	1.103	30.0	30	5	4.100	330	6	9450	162
Shell	B-0180	South Pass Block 24	"T1a" Reservoir B Sand Unit	337	34.2	111	100.0	44	0.362	31.0	9	1	3.096	295	6	8900	162
Shell	B-0402	South Pass Block 24	8000' RS SU (Horstal "S")	338	32	176	500.0	46	0.26	29.0	24	3	14.600	577	11	8150	162
Shell	B-0400	South Pass Block 24	M7 RA SU	339	26	164	200.0	38	0.579	30.0	8	2	3.286	378	4	7350	162
Shell	B-0373	South Pass Block 24	N2 RA SU	340	30	89	200.0	49	0.262	29.0	6	1.4	2.500	333	1	7100	162
Shell	B-0401	South Pass Block 24	R RA SU	341	25	166	500.0	44	0.277	32.0	22	1.3	5.378	166	2	7750	162
Shell	B-0090	South Pass Block 24	RA "M2" SU	342	25	153	200.0	63	0.323	34.0	15	1	19.250	870	11	6650	162
Shell	B-0111	South Pass Block 24	RA "O2" Sand	343	31.1	163	200.0	51.5	0.555	31.8	13	2.5	12.717	804	13	7550	162
Shell	B-0112	South Pass Block 24	RA P-Q Sand	344	35	167	300.0	54.5	0.382	30.0	15	1.5	44.159	1574	27	7860	162
Shell		South Pass Block 24	Res. "C" "T" Sand	346	30	106	300.0	58.5	0.725	32.0	43	2	27.800	460	22	8450	162
Shell		South Pass Block 24	Res. A "T1a" Sand	347	30	175	300.0	60.7	1.161	32.0	23	2	12.300	374	9	8700	162
Shell	B-0097	South Pass Block 24	Reservoir A, "Q" Sand	348	39.5	186	500.0	67.8	0.754	32.0	24	2	17.000	516	9	8125	162
Shell	B-0096	South Pass Block 24	Reservoir A, "U2" Sand	349	32	167	400.0	72	0.452	31.0	30	2	35.900	1028	28	9530	162
Shell	B-0094	South Pass Block 24	Reservoir D, "T" Sand	350	36	184	600.0	42.7	0.409	31.0	12	2	10.900	762	5	9050	162
Shell	B-0141	South Pass Block 24	Rreservoir C "S" Sand	351	33	187	200.0	51.7	0.894	30.7	13	2	9.365	714	11	8750	162
Shell	B-0358	South Pass Block 27	"M" RB SU	353	32.4	178	200.0	65	0.465	30.0	40	9	7.440	150	3	7500	134
Shell	B-0449	South Pass Block 27	"M" Reservoir C Sand Unit	354	32.8	175	500.0	36.18	0.328	32.0	24	4	1.380	37	1	7450	134
Shell	B-0248	South Pass Block 27	"M2" Reservoir A Sand Unit	355	29.5	162	400.0	61	0.574	33.0	39	2.5	39.000	691	17	6775	134
Shell	B-0283	South Pass Block 27	"M2" Reservoir B Sand Unit	356	25	155	500.0	70	0.463	33.0	32	4	8.860	142	5	6280	134

Shell	B-0450	South Pass Block 27	"M2" Reservoir D Sand Unit	357	31.5	170	1000.0	31.59	0.401	32.0	26	7	6.079	170	4	7500	134
Shell	B-0284	South Pass Block 27	"M6" Reservoir A Sand Unit	358	27	159	600.0	59	0.479	33.0	41	4	22.820	360	12	6750	134
Shell	B-0181	South Pass Block 27	"N" Reservoir B Sand Unit	359	26.8	168	300.0	49	0.521	33.0	19	1.5	10.720	359	11	7500	134
Shell	B-0249	South Pass Block 27	"N" Reservoir C Sand Unit	360	32	168	300.0	51	0.42	33.0	17	4.5	10.419	381	9	7400	134
Shell	B-0250	South Pass Block 27	"N" Reservoir D Sand Unit	361	27	161	300.0	47	0.49	32.9	10	2.5	3.706	273	4	7300	134
Shell	B-0285	South Pass Block 27	"N" Reservoir E Sand Unit	362	26	160	200.0	56	0.48	33.0	11	2.5	9.570	557	8	7000	134
Shell	B-0432	South Pass Block 27	"N1a" Reservoir F sand unit	363	27	165	550.0	46	0.407	31.0	26	7	2.755	65	2	7250	134
Shell	B-0182	South Pass Block 27	"N1a" Reservoir B sand Unit	364	26.8	168	300.0	56	0.432	33.0	28	1.5	10.077	270	8	7520	134
Shell	B-0251	South Pass Block 27	"N1a" Reservoir C Sand unit	365	32	168	300.0	64	0.34	33.0	27	4.5	14.387	328	9	7350	134
Shell	B-0252	South Pass Block 27	"N1a" Reservoir D Sand Unit	366	27	161	300.0	51	0.438	33.0	21	2.5	6.238	201	4	7450	134
Shell	B-0286	South Pass Block 27	"N1a" Reservoir E Sand Unit	367	26	160	500.0	64	0.391	33.0	22	5	21.170	529	5	7000	134
Shell	B-0183	South Pass Block 27	"N1b" Reservoir B Sand Unit	368	26.8	168	300.0	27	0.329	33.0	22	1.5	3.458	116	2	7550	134
Shell	B-0253	South Pass Block 27	"N1b" Reservoir C Sand Unit	369	32	168	300.0	52	0.616	33.0	28	4.5	9.173	211	6	7450	134
Shell	B-0254	South Pass Block 27	"N1b" Reservoir D Sand Unit	370	27	161	300.0	57	0.444	33.0	24	2.5	3.589	102	2	7350	134
Shell	B-0433	South Pass Block 27	"N1b" Reservoir F Sand unit	371	28	165	537.0	46	0.478	30.0	35	7	3.692	70	2	7300	134
Shell	B-0287	South Pass Block 27	"N1b" Reservoir E Sand Unit	372	26	160	500.0	45	0.279	33.0	33	2.5	25.320	434	3	7000	134
Shell	B-0288	South Pass Block 27	"N1c" Reservoir E Sand Unit	373	26	160	200.0	44	0.451	33.0	23	2.5	10.480	347	4	7000	134
Shell	B-0403	South Pass Block 27	"N2" Reservoir B Sand Unit	375	27	94	380.0	46	0.667	29.0	18	6	2.400	119	4	7500	134
Shell	B-0435	South Pass Block 27	"N2" Reservoir C Sand unit	376	27	171	144.0	42	0.188	29.0	12	8	0.879	69	2	7600	134
Shell	B-0157	South Pass Block 27	"N4 " Sand, Reservoir "B"	377	24.2	168	400.0	62	0.444	31.5	20	2.5	54.170	1765	47	7800	134
Shell	B-0391	South Pass Block 27	"N4" Reservoir C Sand Unit	379	27.5	170	400.0	78	0.441	31.0	24	9	3.120	77	2	7700	134
Shell	B-0143	South Pass Block 27	"N4" Sand Unit Reservoir A	380	36	190	700.0	65	0.699	31.0	26	7.5	8.433	208	5	8650	134
Shell	B-0158	South Pass Block 27	"N4A" Sand Reservoir A	381	24.2	98	400.0	50.5	0.752	31.0	20	2.5	2.840	136	3	7800	134
Shell	B-0159	South Pass Block 27	"N4a" Sand Reservoir B	382	24.2	168	400.0	59.3	0.511	32.0	28	2.5	16.610	466	11	7800	134
Shell		South Pass Block 27	"N4a" Sand Resevoir A	383	24.2	168	400.0	56.8	0.431	31.0	8	2.5	4.910	593	5	7875	134
Shell	B-0346	South Pass Block 27	"N4b" RC SU	384	26.6	172	200.0	55	0.312	30.0	34	5	7.444	157	7	7600	134
Shell	B-0161	South Pass Block 27	"N4b" Sand Reservoir B	385	24.2	168	400.0	42.4	0.237	31.0	35	2.5	10.890	302	6	7850	134
Shell	B-0184	South Pass Block 27	"No" Reservoir B Sand Unit	386	26.8	168	300.0	39	0.405	33.0	12	1.5	5.236	367	4	7470	134
Shell	B-0256	South Pass Block 27	"No" Reservoir C Sand Unit	387	32	168	300.0	59	0.364	32.2	11	4.5	3.441	276	1	7550	134
Shell	B-0257	South Pass Block 27	"No" Reservoir D Sand Unit	388	27	161	300.0	50	0.361	31.7	10	2.5	5.132	393	8	7650	134
Shell	B-0289	South Pass Block 27	"No" Reservoir E Sand Unit	389	26	160	100.0	50	0.401	33.0	8	2.5	5.980	675	3	7000	134
Shell		South Pass Block 27	"No" sand Reservoir A	390	35	188	700.0	71	0.104	32.0	17	7.5	3.614	134	4	8100	134
Shell	B-0420	South Pass Block 27	Proposed "N2" RE SU	393	30	190	500.0	70	0.234	31.0	26	6	1.209	36	0	8650	134
Shell		South Pass Block 27	Proposed "N2" RG SU	394	35	191	500.0	48	0.731	31.0	16	6	1.903	102	1	8750	134
Shell	B-0422	South Pass Block 27	Proposed 'N4" RI SU	395	31	191	500.0	70	0.458	31.0	13	6	0.458	27	1	8750	134
Shell	B-0498	South Pass Block 27	Proposed 01 RH SU	396	32	177	300.0	44.85	0.696	30.0	25	7.5	0.985	53	1	8100	134
Shell	B-0436	South Pass Block 27	Proposed SPB 27 K RA SU	397	27.5	160	500.0	57	0.484	28.0	17	10	4.080	174	2	6200	134
Shell	B-0437	South Pass Block 27	Proposed SPB 27 K RB SU	398	27.5	160	500.0	43	0.765	32.0	13	6	1.038	54	1	6300	134
Shell	B-0434	South Pass Block 27	Proposed SPB 27 M RD SU	399	32	175	500.0	58.1	0.371	32.0	11	7	2.888	181	5	7530	134
Shell	B-0431	South Pass Block 27	Proposed SPB 27 N4 RD SU	400	31	181	500.0	46	0.656	31.0	11	10	0.228	18	1	8660	134
Shell	B-0115	South Pass Block 27	Reservoir "A" "L2" Sand Unit	401	25.6	153	200.0	60.4	0.324	33.4	33	3	30.180	992	25	6420	134
Shell	B-0496	South Pass Block 27	SPB27 L2 RC SU	402	29	165	500.0	42	0.418	33.0	7	7.5	1.152	120	3	7350	134
Shell	B-0504	South Pass Block 27	SPB27 L2 RE SU	403	31	80	300.0	57.62	1.152	30.0	14	3	2.589	158	3	7200	134
Shell	B-0497	South Pass Block 27	SPB27 L4 RD SU	404	32	93	300.0	35	0.569	32.0	16	7.5	2.240	120	2	7430	134
Exxon	B-0359	Southeast Pass	J-5 Sand RA	405	37.3	172	1329.0	70	0.598	30.2	15	2.7	11.598	541	9	7665	146
Humble	B-0098	Southeast Pass	K Sand, Reservoir C	406	33.9	178	1368.0	87	0.791	29.6	34	3.5	22.404	430	13	8040	146
Conoco	B-0212	Tepetate	Ortego "A"	416	38.5	154	3485.0	49.72	0.671	31.6	18	5	47.848	1500	12	8300	63
Gulf	B-0147	Timballer Bay	D-14 Sand, "G" Fault Block	418	32.1	211	180.0	54.8	0.98	25.5	39	8	2.412	60	3	11400	81
Gulf		Timballer Bay	D-3-4 Sand, Reservoir A	420	33	106	400.0	44	1.013	29.0	35	14.5	2.696	58	1	8450	81
Gulf	B-0325	Timballer Bay	D-5 Sand, Reservoir B	422	32.5	112	245.0	59.6	0.678	28.0	38	12	20.175	501	20	8987	81
Gulf	B-0378	Timballer Bay	S-1D Sand, Res BA	427	29	175	300.0	46.2	0.272	26.0	30	10	1.604	41	2	6850	81
General Americ	B-0117	Valentine	"N" Sand Reservoir A	430	37	104	39.6	50.3	0.583	30.9	25	33	4.169	112	3	8300	51
General Americ	B-0443	Valentine	Val "N" RC SU	431	39.5	103	373.0	40.9	0.485	32.9	30	33	3.848	80	1	8276	51
Texaco	B-0393	Vatican	Bol Mex Reservoir B	432	37	205	316.0	45.1	0.758	28.0	7	4	3.170	429	4	10800	38.7
Conoco	B-0476	Ville Platte	Basal Cockfield RI	435	32	185	66.0	68	0.389	23.2	10	5	2.420	224	2	8030	67
Conoco	B-0469	Ville Platte	Basal Cockfield RD	436	32.3	185	66.0	69.3	0.666	24.6	7	5	1.430	168	1	8000	67
Conoco	B-0468	Ville Platte	Middle Cockfield RA	437	37.4	185	38.0	60.5	0.731	28.5	5	5	2.516	448	1	7833	67

Gulf		West Bay	11 Sand Fault Block B	439	30	136	500.0	70	1.163	30.0	55	3	28.200	438	19	10850	126
Gulf		West Bay	16A Marker Sand FB "J-D-D2" Proposed (RA) Sa	440	30	80	100.0	68	0.62	32.4	14	6	2.629	153	2	6300	126
Gulf	B-0466	West Bay	5 (RD) SU	441	36.9	166	500.0	40	0.256	32.9	29	9	1.203	29	1	7270	126
Gulf	B-0424	West Bay	5 A 'B'	442	33	104	500.0	40	0.774	31.5	23	8	2.592	74	3	7000	126
Gulf		West Bay	8 A Sand Fault Block A	445	34	115	228.0	72	0.789	28.4	23	3.2	29.041	1032	20	9235	126
Gulf	B-0262	West Bay	8 AL Sand	446	35	182	380.0	82	0.59	30.6	12	1.4	18.689	1461	26	9100	126
Gulf		West Bay	Proposed WB6B (RG) Sand Unit	449	31.3	80	470.0	58	1.306	32.6	41	4.5	49.700	530	21	7419	126
Gulf	B-0185	West Bay	WB 1 (FBA) SU	450	30	80	500.0	75	1.054	34.0	14	3	12.800	547	18	6180	126
Gulf		West Bay	WB 7 RD SU	453	33.4	101	500.0	37.9	0.465	30.0	52	4.6	4.439	59	3	8070	126
Pennzoil Producing Co		West Bay	X-11 Sand (Reservoir C)	454	31.2	212	579.0	51.7	0.816	29.9	11	4.3	1.867	141	2	10280	126
Pennzoil Produ	B-0186	West Bay	11 Sand (Reservoir A)	455	27.2	206	594.0	58.6	0.722	30.8	21	4.1	18.269	683	14	10473	126
Pennzoil Produ	B-0297	West Bay	X-11 (Reservoir A)	457	27.8	212	719.0	64	0.211	29.7	14	3.6	13.110	724	8	10289	126
Pennzoil Produ	B-0298	West Bay	X-11 (Reservoir B)	458	28.4	208	636.0	53.3	0.156	30.6	13	3.3	3.672	225	1	10393	126
Pennzoil Produ	B-0296	West Bay	X-9 A Sand (Reservoir A)	459	28.5	192	1180.0	69.4	0.665	29.1	21	3.3	13.280	466	9	9490	126
Gulf	B-0465	West Bay	10 Sand, Reservoir 'A'	460	28	207	200.0	48.04	0.426	28.0	16	6	2.542	131	5	9841	126
Gulf	B-0462	West Bay	9 Sand, Res 'A'	462	30	220	200.0	24.7	0.509	29.0	25	5	9.034	290	19	9133	126
Gulf		West Bay	WB 3A (FBB) S U	463	31.8	170	500.0	55	0.987	33.0	30	4.3	1.875	40	1	7100	126
Texaco	B-0427	West Cote Blanche B	8100' Sand, Res N, N3, N4	467	33.3	128	600.0	49.4	0.354	30.4	16	23	1.447	57	0	8500	4
Texaco	B-0301	West Cote Blanche B	Lower No. 11 Sand, Reservoir N3	468	33.8	108	1200.0	81	1.495	33.0	84	27	6.960	40	1	8600	4
Texaco		West Cote Blanche B	Lwr 8 R G-R	470	30.9	126	1058.0	43.1	0.827	29.0	31	31	2.232	54	11	8400	4
Texaco		West Cote Blanche B	No. 11 Sand, Seg Q-U	472	32	128	305.0	75	0.671	29.0	78	20	4.433	27	4	8500	4
Texaco	B-0195	West Cote Blanche B	No. 17 Sand. Res. P-Q	475	33.1	116	400.0	57	1.314	28.0	42	20	4.651	75	1	7700	4
Texaco		West Cote Blanche B	No. 38 Sand, Seg. E2	479	30.3	180	64.0	82	0.186	25.0	24	22	3.932	146	5	12011	4
Texaco		West Cote Blanche B	Upper 11 Sand, Reservoir C	483	32	124	360.0	60.2	1.326	26.0	39	16	0.894	19	1	8278	4
Chevron	B-0118	West Delta Block 83	10100' C Sand	487	35.5	196	200.0	62	0.611	28.0	20	2	60.505	2417	50	10100	130
Michel T. Halbo	B-0321	West Hackberry	2nd Cameron	490	27.4	154	212.0	71	0.335	29.6	43	64	2.208	36	1	6500	99
Pan American	B-0274	West Hackberry	Camerina C Sand - FB 5	491	28.1	176	800.0	74	0.303	28.4	100	55	10.982	87	8	7875	99
Amoco	B-0492	West White Lake	Big (3)-2, RE, RC	498	37	160	200.0	57	0.458	26.0	7	5	13.380	3040	39	7050	47
Amoco	B-0501	West White Lake	Big(3)-2 RE, RC	499	37	160	200.0	57	0.548	26.0	7	5	13.380	3040	39	7050	47
Shell	B-0485	White Castle	"O1" RF SU	500	30	109	200.0	65	0.286	30.0	175	53	0.500	2	1	5000	8

APPENDIX D

SPE 35431

Screening Criteria for Application of Carbon Dioxide Miscible Displacement in Waterflooded Reservoirs Containing Light Oil

Daniel Díaz, SPE, Zaki Bassiouni, SPE, William Kimbrell, SPE, and Joanne Wolcott, SPE,
Louisiana State University

This paper was prepared for presentation at the SPE Improved Oil Recovery Symposium held in Tulsa, OK, U.S.A., 21-24 April, 1996.

Abstract

In conjunction with a joint Texaco/DOE research project, the LSU Department of Petroleum Engineering developed an improved method of screening reservoirs for the application of the carbon dioxide miscible enhanced oil recovery (EOR) process. This method, which can be applied to a large number of reservoirs, considers both the technical and economic feasibility of the EOR process.

The technical parameters of each reservoir are first compared to those of an "ideal" reservoir; and from that comparison, each reservoir is assigned a technical ranking. The technical ranking is used to estimate expected recovery. Key technical parameters used in the screening process are remaining oil in place, minimum miscibility pressure, reservoir depth, oil API gravity, and formation dip angle.

The reservoirs are subsequently screened for economic feasibility based on standardized capital costs and operation expenses that are representative of the reservoirs under consideration. The reservoirs are finally ranked based on the present worth value of revenues to costs ratio.

Using this method, we screened a database containing 197 light-oil reservoirs in Louisiana. The database includes three reservoirs where CO_2 miscible floods are ongoing; these reservoirs ranked first, fifth, and thirtieth. The high ranking of these reservoirs, which were identified based on detailed and comprehensive reservoir studies, validates the screening method.

Different application options in a specific reservoir can be screened, if warranted, by using CO_2 -PROPHET, a PC compatible software. CO_2 -PROPHET is a relatively simple numerical model capable of simulating water and gas floods. An example of its application is included.

Introduction

In 1992, Texaco Exploration and Production Inc. (TEPI) and the U. S. Department of Energy (DOE) entered into a cost-sharing cooperative agreement to conduct an enhanced oil recovery demonstration at Port Neches field, Orange County, Texas. The agreement was formulated under the DOE Class I oil program, which encourages the development of innovative technical approaches to enhanced oil recovery. The innovative aspect of this project is the application of CO_2 miscible flooding in waterflooded light-oil fluvial-dominated reservoirs. TEPI agreed to disseminate the knowledge and the experience gained at Port Neches to other operators in the petroleum field.

Louisiana State University (LSU) has agreed to assist TEPI with technology transfer efforts. LSU's role was mainly to identify and rank waterflooded Louisiana reservoirs where the CO_2 EOR process may be used. To achieve this goal, LSU needed to develop a screening process that could be applied to reservoirs listed in the Louisiana Office of Conservation database. To be meaningful to interested operators, the screening method had to consider both the technical and economic feasibility of the EOR process. Because economic feasibility depends highly on CO_2 availability, identifying CO_2 sources and their distances to prospective reservoirs was imperative.

Once a prospect is identified, management options need to be considered. This task requires a user friendly numerical simulator. The effect of reservoir heterogeneity and well locations which is not considered in the initial screening can be investigated during the numerical simulations.

Screening for Technical Feasibility

Screening is usually performed following certain guidelines and criteria developed from laboratory tests and field experience. Screening methods include reservoir performance prediction, binary comparison, and parametric optimization. Reservoir performance prediction was excluded because of the relatively large number of reservoirs screened.

Binary comparison is easy to perform; it involves comparing a candidate reservoir's parameters against established ranges. The binary screening method does not, however, account for the synergistic effects of reservoir parameters. For example, with the binary comparison method, a reservoir that has properties marginally within the recommended ranges would be selected over a reservoir that has very good values of all properties except one.

We used a parametric optimization method developed by Rivas *et al.*[1] Their screening method is based on determining for each property (j) of the reservoir (i) being ranked a corresponding normalized parameter, $X_{i,j}$, defined by:

$$X_{i,j} = \frac{|P_{i,j} - P_{o,j}|}{|P_{w,j} - P_{o,j}|} \quad \text{(1)}$$

where $P_{o,j}$ is the magnitude of the property (j) in a fictitious reservoir called the optimum reservoir, which gives the best response to CO_2 flooding. $P_{w,j}$, on the other hand, is the value of the property (j) in another fictitious reservoir, called the worst reservoir, which is not suited to CO_2 flooding. The variable $X_{i,j}$ varies linearly between 0 and 1.

Because an exponential function is more adequate than a linear function for comparing different elements within a set, the normalized linear parameter, $X_{i,j}$, is transformed to exponential varying parameter, $A_{i,j}$ using the following heuristic equation:[1]

$$A_{i,j} = 100\, e^{-4.6 X_{i,j}^2} \quad \text{(2)}$$

$A_{i,j}$ ranges from a minimum of 1 to a maximum of 100.

To take into account the relative importance, or weight, of each reservoir parameter, a weighted grading matrix, $W_{i,j}$, is determined as follows:

$$W_{i,j} = A_{i,j} w_j, \quad \text{(3)}$$

where w_j is the weight of property (j).

The reservoirs are then ranked using a ranking parameter, R_i, defined as:

$$R_i = 100 * \frac{\sum_{j=1}^{j} M_{i,j}}{\sum_{j=1}^{j} M_{1,j}}, \quad \text{(4)}$$

where $M_{i,j}$ is the product of the weighted matrix $W_{i,j}$ by its transpose, $W_{j,i}$.

The parameters used in the parametric optimization screening are oil API gravity, reservoir temperature, saturation of oil before the process application, porosity, permeability, ratio of reservoir pressure to CO_2 minimum miscibility pressure, net pay oil thickness, and reservoir dip. Other important parameters such as oil viscosity, gas to oil ratio, and bubble-point pressure were excluded for simplicity purposes. These properties, however, correlate with oil gravity, which is included in the screening.

The properties of the optimum reservoir, $P_{o,j}$, used in equation 1 were obtained by performing numerical simulation on a base case to determine the set of parameters that optimized reservoir response to CO_2 flooding. The relative importance or weight of each parameter on process performance was determined from the average normalized slopes of the reservoir performance around the optimum value of the parameter.[1] Optimum reservoir parameters and weighting factors are given in Table 1.

The properties of the worst reservoir, $P_{w,j}$, are determined using the data of the reservoirs to be ranked. The value farthest away from the optimum is the worst value. It is conceivable to have two worst values, one lower and one higher than the optimum. Worst parameters of the reservoirs considered in this study are listed in Table 2.

CO_2 Sources and Providers in Louisiana

Critical to the economic feasibility of the process is the availability and location of CO_2 sources. A list of CO_2 industrial sources and providers was compiled through personal interviews and by reviewing a brochure published by the Louisiana Chemical Association.[2] Some potential commercial sources/providers of CO_2 were also identified from a computer database compiled by Louisiana State University.[3]

Naturally occurring CO_2 reservoirs are associated with the Jackson Dome geologic structure in Mississippi. Shell operates a pipeline that runs from Jackson Dome to Week's Island field. The pipeline has two sections: a 20 inch and a 10 inch. The 20-inch pipeline crosses from Mississippi into Louisiana in St. Helena Parish and continues across St. Helena, Livingston, East Baton Rouge, Ascension, and Iberville parishes. A site just northeast of Pierre Part serves as a pumping station where the 20-inch and 10-inch pipelines connect. The 10-inch pipeline crosses Assumption, St. Martin, St. Mary, and Iberia parishes, and terminates at Week's Island field. The last 16 miles of this pipeline were leased and are temporarily being used for hydrocarbon transportation. The remaining northern portion is still used to transport a small amount of CO_2 to Shell projects. The pipeline is available for tap-ins. Figure 1 shows fields with at least one waterflooded reservoir, plant sources of CO_2, and the location of the Shell pipeline.

Economic Screening

To be practical, the screening method considers the economic feasibility of the process. The economic screening was based on before-tax, present-worth, benefit-to-cost ratio. The economic evaluation relied heavily on data and experience gained from similar projects. Data specific to the reservoir at hand was limited to initial oil in place, area, depth, number of wells, distance to the CO_2 source, and the ranking characteristic parameter calculated in the technical screening phase.

In determining the project's cost, it was assumed that the CO_2 project could take advantage of the existing infrastructure. It was also assumed that the operating cost is charged to the CO_2 project. This last assumption implies that production from the candidate reservoir is at or near the economic limit.

Production Schedule. Recent studies[4,5] of many field-scale CO_2 projects concluded that vastly different projects exhibit similar production responses to CO_2. Based on these studies, the estimated potential recovery of the CO_2 process when applied to an optimum reservoir is 15% of the original oil in place, N. The potential recovery from the reservoirs in the database is obtained by multiplying the optimum recovery by the ranking parameter, R_i. This is expressed by:

$$N_{pi} = 0.15 * N * R_i \quad (5)$$

The potential recovery is produced according to the schedule shown in Figure 2. The expected life of the project is 15 years. The annual revenues are calculated using the schedule with the price of oil set at $17/STB in the base case.

Capital Outlay. The capital needed to start a CO_2 project is field dependent. However, estimates using typical costs are acceptable for the purpose of screening. Capital outlay considered in this screening accounted for costs of new wells, pipeline to the CO_2 source, and injection and production equipment. Other equipment was assumed to be available as part of the existing infrastructure.

Drilling and completion cost, C_d, was estimated using the following equation developed in a DOE study:[6]

for onshore wells, $C_d = 30{,}430 * n * e^{0.00035D}$, ... (6)

and for offshore wells, $C_d = 688{,}514 * n * e^{0.00011D}$, ...(7)

where C_d is the drilling and completion cost, in U.S. dollars;
D is the formation depth in feet; and
n is the number of required new wells.

The number of required new wells depends on the optimum spacing and the number of active wells. It is estimated from:

$$n = \frac{A}{S} - n_a \quad (8)$$

where A is the reservoir area in acres;
n_a is the number of active wells; and
S is the optimum spacing.

For the purpose of screening, S is assumed in the base case to be 40 acres for onshore reservoirs and 80 acres for offshore reservoirs. The number of total wells, n_t, should not be less than two, an injector and a producer, or:

$$n_t = n + n_a \geq 2 \quad (9)$$

Injection and production equipment costs, C_{inj} and C_{pd} respectively, were estimated from the same DOE study using the equations:[6]

$$C_{inj} = 22{,}892\, n_{inj}\, e^{0.00009D} \quad (10)$$

and $C_{pd} = 24{,}908\, n_p\, e^{0.00014D}$, ... (11)

where D is the formation depth in feet;
n_p is the number of producers; and
n_{inj} is the number of injection wells, which is taken to be half of the total number of wells.

For projects requiring CO_2 injection, CO_2 can be transported by tank truck, railcar, or pipeline. Transportation by pipeline is considered the least expensive of all these methods.[5] Depending on the pipeline pressure conditions, CO_2 can be transported either at subcritical or supercritical conditions or as a liquid. The supercritical CO_2 pipeline system is the most economical system for transporting the large quantities of CO_2 needed for enhanced oil recovery.[7] The following equation can be used to estimate the cost of the pipeline:[6]

$$C_{pip} = (100{,}000 + 2{,}008\, q_{inj}^{0.834})\, d \quad (12)$$

where C_{pip} is the pipeline cost in U.S. dollars;
d is the distance to the Shell pipeline, in miles; and
q_{inj} is the estimated CO_2 pipeline capacity, in MMSCF/D.

q_{inj} is estimated from the following correlation:[6]

$$q_{inj} = 2 * N_{pi} \quad (13)$$

where N_{pi} is the projected incremental oil in million barrels estimated by Equation 5, in STB.

If more than one reservoir is located in the same field, the pipeline cost is shared by the reservoirs. The pipeline capacity is calculated from Equation 13 using the incremental production from all the reservoirs to share the cost. The pipeline cost, C_{pip}, calculated from Equation 12 is then shared between the reservoirs on the basis of the individual incremental oil value. All capital outlay is charged during the first year of the project.

CO_2 Cost. Published studies suggest that 6 MSCF per one STB of incremental oil is a representative average value of CO_2 utilization.[4,8] The purchase of CO_2 is a major expense for miscible projects, especially if CO_2 is obtained from industrial sources. The CO_2 cost for the purpose of this screening was based on availability from natural sources via the Shell pipeline. The CO_2 cost was estimated at $0.60/MSCF and remained constant throughout the injection period. The CO_2 project was not burdened with separation and recycling costs.

t was assumed that the value of produced natural gas would offset the cost of CO_2/natural gas separation.

Operating costs. Operating costs are site and operator specific. The average annual operating cost, C_{op}, in U.S. dollars, however, can be predicted from the following equation:[6]

$$C_{op} = 13{,}298\, n_t e^{0.00011D} \quad \text{(14)}$$

It is assumed that all wells will require future workovers at an average of 0.25 workovers per well per year. The cost of a workover is estimated to be half the cost of the equipment. The annual workover cost, C_{wo}, can then be determined using the following equation:

$$C_{wo} = 0.25\left(\frac{n_t}{2}\right)\left(C_{inj} + C_{pd}\right) \quad \text{(15)}$$

where C_{inj} and C_{pd} are expressed by equations 10 and 11, respectively.

Both the technical and economic screening algorithms were written in FORTRAN™ code. The economic screening may also be run on an electronic spreadsheet.

Louisiana Waterflooded Reservoirs Database

The approach described in this paper was used to screen waterflooded reservoirs in Louisiana. These reservoirs are listed in a database available from the Louisiana Office of Conservation and Reserves. Initially, the database listed 499 reservoirs that were waterflooded. These reservoirs represented a total original-oil-in-place of 5.289 billion STB, or an average of 10.6 million STB/reservoir.

Many reservoirs were eliminated in the initial stage of screening for various reasons. Because of the high cost of transporting CO_2, all of the 101 reservoirs located in North Louisiana were eliminated. An additional 188 reservoirs, mostly inactives, were eliminated because current saturation and pressure data, two key screening parameters were unavailable. Inconsistent data also led us to eliminate 13 reservoirs, leaving 197 reservoirs for screening and ranking.

Screening Results. Table 3 lists the 40 top ranked reservoirs and their relevant data. The reservoirs are ranked based on before-tax, present-worth, benefit-to-cost ratio. The economic evaluation considered shared pipeline cost. A discount rate of 15% was used in the base case. A positive value of the benefit-to-cost ratio indicates profitability.

As expected, the final ranking did not correlate with the technical ranking parameter, R_i. Under the conditions established for the model, the majority of the possible candidates are not economically suitable for miscible displacement with CO_2. Only 20% of the reservoirs in the database look economically attractive. Nevertheless, the potential incremental oil from these reservoirs is a significant 70.6 MMSTB of oil. The economic potential of CO_2 depends on the well spacing, CO_2 price, oil price, and discount factor.

The ranking shown in Table 3 was for a base case in which a 40-and 80-acre spacing were used for onshore and offshore reservoirs, respectively. The base case used 0.6$/Mcf, 17$/STB and 15% for CO_2 price, oil price, and discount factor. Sensitivity of the CO_2 performance to these parameters is shown in Table 4.

The validity of the screening approach is demonstrated by the fact that of the CO_2 projects contained in the database are highly ranked. These cases were considered to be profitable by the individual operator prior to the implementation of the process.

Specific Reservoir Performance

The objective of the reservoir screening and ranking is to attract the attention of operators to the potential of the miscible CO_2 EOR process in waterflooded reservoirs. Once this is accomplished, it is presumed that the operator will be interested in the absolute performance of a specific reservoir as opposed to its ranking relative to other reservoirs in the database. A user-friendly numerical simulator allows the screening of different implementation options. The effects of reservoir heterogeneity and well locations, which were not included in the initial screening, can be considered. Additional parameters can also be included in the simulation. CO_2-PROPHET™ software was recommended to perform this task.[8]

CO_2-PROPHET, a water-and gas-flood prediction software, was developed by Texaco with support of the U.S. Department of Energy. The simulator has been shown to be a good tool for screening and reservoir management and is being released with a detailed user manual to the industry. The hardware required to run CO_2-PROPHET includes an Intel® 386-based PC or better with at least 4 megabytes of RAM and 4 megabytes of free disk space. A math coprocessor is required for the 386 or the 486SX systems.[8]

This software runs on PC compatible computers. Some of its features include: easy reservoir parameter input; several predefined patterns to simplify use; the ability to design patterns to fit most situations; fast computation; multiple flood regimes that model water, gas, and miscible floods; output in surface units and dimensionless formats; and output designed for importing data into a spreadsheet.[8]

CO_2-PROPHET computes streamlines between injection and production wells to form stream tubes. It then makes flow computations along the stream tubes. It uses the Dykstra-Parsons coefficient to distribute the initial injection into a maximum of ten layers. A new case can be set up and run in a few minutes, making this program ideal for screening of EOR projects and pattern comparisons.

The use of CO_2-PROPHET is demonstrated with one of the top-ranked reservoirs, fictitiously named Eden. The Eden reservoir is located in a salt dome related structure. Its initial pressure in 1949, when commercial development began, was 4500 psi. The reservoir had a large initial gas cap about 0.444

the size of the oil zone. The estimated original-oil-in-place was 11.7 million barrels of 35.2 API gravity oil. By 1972, the reservoir had produced 2.6 millions of barrels of oil, mostly due to gas cap expansion. In 1974, a waterflooding program was initiated to increase recovery. As of 1990, waterflooding had resulted in the recovery of 4.3 millions barrels of oil.

The Eden reservoir was simulated using an option that allowed for the development of a stream tube model which was stored for later investigation of implementation options. Figure 3 shows the stream tube model of the Eden reservoir and the well locations.

Two implementation options were investigated: waterflooding and waterflooding followed by hybrid CO_2 displacement. For the waterflooding option, the startup conditions were those existing in 1974 at the end of the primary recovery phase. A total of 1.25 pore volumes (P.V.) of water was injected in the waterflooding option. The hybrid CO_2 process started after 0.7 P.V. of water was injected. The two options are compared in Table 4 and Figure 4. Figure 4 shows the expected cumulative oil recovery versus time. These data can be imported to a spreadsheet for site and operator specific economic evaluation.

Conclusions and Recommendations

A screening model was developed to rank a large number of potential reservoirs in a short period of time and with little effort. The model provides for rapid evaluation of both the technical and economic feasibility of the CO_2 miscible process. Of the 197 waterflooded reservoirs screened in this project, 39 looked economically attractive. The potential incremental recovery from these reservoirs is 70.6 million STB. To complement the screening model, CO_2-PROPHET numerical sumulator was used. This software allowed to incorporate site- and operator-specific data that are not considered in the initial screening.

Acknowledgments

The authors are grateful for the financial support provided by Texaco Inc., and the Department of Energy. We also thank the assistance of the LSU petroleum engineering department staff.

References

1. Rivas, O., Embid S. and Bolivar, F.: "Ranking Reservoirs for CO2 Flooding Processes," paper SPE 23641 presented at the 1992 SPE Latin American Petroleum Engineering Conference, Caracas, March 8 -11.
2. Louisiana Chemical Association : "A Visitor's Guide to the Louisiana Chemical Industry," January 1993.
3. Pine, J.: "SARA Title-3 Database," Louisiana State University, 1993.
4. Flanders, W. A. and DePauw, R. M.: "Update Case History : Performance of the Twofreds Tertiary CO_2 Project" paper SPE 26614 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3 - 6.
5. Robl, F. W., Emanuel, A. S., and, Van Meter Jr., O. J.: "The 1984 National Petroleum Council Estimate of Potential EOR for Miscible Process," *JPT* (Aug. 1986), 875 - 882.
6. Klins, M. A.: *Carbon Dioxide Flooding*, IHRC, Boston (1984).
7. Martin, F. D.: "Enhanced Oil Recovery for Independent Producers," paper SPE 24142 presented at the SPE/DOE Eight Symposium on Enhanced Oil Recovery, Tulsa, April 22-24, 1992.
8. Dobitz, J. K. and Prieditis J.: "A Stream Tube Model for the PC," paper SPE 27750 presented at the SPE/DOE Ninth Symposium on Improved Oil, Tulsa, April 17 - 20, 1994.

SI Metric Conversion Factors

acre × 4.046 873	E+03	= m^2
°API 141.5/(131.5+°API)		= g/cm^3
bbl × 1.589 873	E-01	= m^3
cp × 1.0*	E-03	= Pa-s
ft × 3.048*	E-01	= m
ft^3 × 2.831 685	E-02	= m^3
°F × (°F-32)/1.8		= °C
mile × 1.609 344*	E+00	= km
psi × 6.894 757	E+00	= kPa

* Conversion factor is exact

Table 1: Optimum Reservoir Parameters and Weighting Factors.[1]

Parameter	Optimum	Weight
API Gravity	37	0.24
Oil saturation, %	60	0.20
Pressure/ MMP	1.30	0.19
Temperature, °F	160	0.14
Net oil thickness, ft	50	0.11
Permeability, md	300	0.07
Dip, °	20	0.03
Porosity, %	20	0.02

Table 2: Worst Parameters from Louisiana's Reservoir Database.

Parameter	Lower Limit	Upper Limit
API Gravity	24	48
Oil saturation, %	8	80
Pressure/ MMP	0.10	1.47
Temperature, °F	80	276
Net oil thickness, ft	5	175
Permeability, md	17	3485
Dip, °	0.03	64
Porosity, %	17.6	34

Table 3: Potentially profitable reservoirs for CO2 miscible displacement in Louisiana

Base case: 197 reservoirs with complete information

Prospect Identification			Reservoir Parameters				Screening Parameters								Tech.	Economic Parameters			Rank
Operator	Field	Reservoir	Depth Feet	EOOIP MMBbl	Recov. MMBbl	Area Acres	API	Temp o F	Perm, K, md	So %	P/MMP	Poros. %	H oil Feet.	dip o	Rank	Wells Now	New Wells	Shared Dist, mi	40/80 15 %
Texaco	Paradise	Lower 9000 Sand RM	10450	13.5	1.7	235	35.7	193	515	62.0	0.909	28.8	45	8	85.04	6	0	1.0	1.14
Hassie	South Pass Block 24	8800' RD	8295	36.7	3.1	960	30.0	178	447	61.0	0.341	26.0	39	3	55.79	12	0	11.6	1.04
Shell	South Pass Block 27	"N1b" Reservoir F Sand unit	7300	3.7	0.2	70	28.0	165	537	43.5	0.478	30.0	35	7	42.99	1	0	1.4	0.96
Shell	Eugene Island Block 18	"O" Sand	10071	35.6	4.1	273	38.5	151	1000	31.3	1.866	32.0	80	4	76.50	3	0	59.0	0.95
Texaco	Paradise	Main Pay RT SU	10300	11.7	1.3	114	36.8	205	1910	51.7	0.752	27.5	51	10	74.25	2	1	1.0	0.93
Shell	South Pass Block 27	"M" RB SU	7500	7.4	0.7	150	32.4	178	200	47.5	0.465	30.0	40	9	60.03	3	0	3.9	0.89
Shell	South Pass Block 27	"N1b" Reservoir C Sand Unit	7450	9.2	0.6	211	32.0	168	300	22.9	0.616	33.0	28	5	44.22	3	0	3.5	0.82
Texaco	Caillou Island	Upper 8000 RA SU	7900	6.4	0.6	182	38.2	103	285	17.1	1.484	31.0	25	18	58.62	2	0	6.0	0.76
Shell	South Pass Block 27	"N1a" Reservoir C Sand unit	7350	14.4	1.1	328	32.0	168	300	36.9	0.340	33.0	27	5	49.67	6	0	6.2	0.72
Gulf	West Bay	Proposed WB6B (RG) Sand Unit	7419	49.7	3.6	530	31.3	80	470	38.4	1.306	32.6	41	5	48.52	5	2	29.9	0.71
Shell	South Pass Block 27	Proposed SPB 27 K RA SU	6200	4.1	0.3	174	27.5	160	500	54.4	0.484	28.0	17	10	48.61	2	0	1.7	0.69
Gulf	West Bay	5 A 'B"	7000	2.6	0.2	74.2	33.0	104	500	39.1	0.774	31.5	23	8	48.39	1	0	1.6	0.68
Shell	South Pass Block 27	"N4b" RC SU	7600	7.4	0.5	157	26.6	172	400	48.8	0.312	30.0	34	5	43.61	3	0	2.8	0.63
Shell	South Pass Block 27	"N1b" Reservoir D Sand Unit	7350	3.6	0.2	102	27.0	161	300	29.0	0.444	33.0	24	3	28.74	1	0	0.9	0.61
Shell	South Pass Block 24	Reservoir A, "Q" Sand	8125	17.0	1.7	516	39.5	186	500	21.5	1.161	32.0	24	2	66.09	5	1	6.4	0.61
Shell	South Pass Block 27	"M2" Reservoir A Sand Unit	6775	39.0	3.4	691	29.5	162	400	57.4	0.574	33.0	39	3	58.15	6	3	19.7	0.58
Shell	South Pass Block 27	"M6" Reservoir A Sand Unit	6750	22.9	1.2	360	27.0	159	600	33.9	0.479	33.0	41	4	34.24	9	0	6.8	0.52
Shell	South Pass Block 27	"N1b" Reservoir B Sand Unit	7550	3.5	0.1	116	26.8	168	300	26.7	0.329	33.0	22	2	26.03	1	0	0.8	0.48
Shell	South Pass Block 24	RA P-Q Sand	7860	44.2	3.8	1574	35.0	167	300	24.3	0.555	30.0	15	2	57.34	18	2	14.3	0.46
Shell	South Pass Block 27	"N1b" Reservoir E Sand Unit	7000	25.3	1.5	434	26.0	160	500	44.8	0.279	33.0	33	3	40.31	3	2	8.9	0.31
Shell	South Pass Block 24	8000' RS SU (Horstal "S")	8150	14.6	1.1	577	32.0	176	500	42.2	0.362	29.0	24	3	52.39	11	0	4.3	0.27
Gulf	Quarantine Bay	9BC, C2	9430	3.1	0.3	90	35.9	200	200	32.0	0.946	28.0	20	2	60.63	1	0	6.4	0.26
Chevron	Bay Marchand Blk 2	3650' Upper Block D, 3650' (U)	3850	26.8	0.8	167	24.0	136	570	11.4	0.352	32.0	78	17	18.99	2	0	24.0	0.24
Chevron	South Pass Block 24	8200' "T" Sand	8294	84.3	6.4	1456	32.0	104	325	43.2	0.819	31.8	45	2	50.98	9	9	24.2	0.24
Shell	South Pass Block 24	Res. A "T1a" Sand	8700	12.3	0.7	374	30.0	175	300	32.3	0.725	32.0	23	2	39.59	7	0	2.8	0.21
Shell	South Pass Block 27	"N2" Reservoir B Sand Unit	7500	2.4	0.1	119	27.0	94	380	41.4	0.667	29.0	18	6	25.98	1	0	0.5	0.20
Shell	South Pass Block 27	"N4b" Sand Reservoir B	7850	10.9	0.4	302	24.2	168	400	22.7	0.237	31.0	35	3	24.22	4	0	2.3	0.20
Texaco	West Cote Blanche Bay	Lower No. 11 Sand, Reservoir N3	8600	7.0	0.6	40	33.8	108	1200	36.4	1.495	33.0	84	27	59.13	1	1	1.2	0.14
Texaco	West Cote Blanche Bay	No. 17 Sand. Res. P-Q	7700	4.7	0.5	75	33.1	116	400	44.1	1.314	28.0	42	20	66.76	0	1	0.9	0.12
Texaco	Paradise	Paradis Zone, Seg. A-B	10000	119.0	14.6	2057	38.0	200	1348	60.0	0.872	26.2	55	4	81.73	8	43	1.0	0.10
Chevron	South Pass Block 24	8600' RA Sand Unit	8721	85.3	7.0	1496	32.4	179	500	35.7	0.734	31.0	43	2	54.95	7	12	26.5	0.09
Shell	South Pass Block 27	"N1a" Reservoir E Sand Unit	7000	21.2	0.9	529	26.0	160	500	31.5	0.391	33.0	22	3	28.49	6	1	5.3	0.08
Gulf	Grand Bay	GB 10B (FBB) RA SU	7870	7.7	0.7	440	35.3	98	300	23.9	1.402	32.6	11	2	56.17	6	0	10.5	0.05
Gulf	West Bay	11 Sand Fault Block B	10850	26.2	2.4	436	30.0	136	500	47.3	1.163	30.0	55	3	60.26	2	3	19.7	0.05
Shell	South Pass Block 27	"N1c" Reservoir E Sand Unit	7000	10.5	0.4	347	26.0	160	200	22.3	0.451	33.0	23	3	23.00	5	0	2.1	0.05
Texaco	Caillou Island	9400 ft Sand, RBB1C	10000	23.3	2.3	427	39.0	138	1900	17.3	1.113	30.0	44	12	64.42	2	3	23.8	0.03
Shell	South Pass Block 27	SPB27 L4 RD SU	7430	2.2	0.1	120	32.0	93	300	43.9	0.569	32.0	16	8	43.09	2	0	0.8	0.02
Gulf	Quarantine Bay	8 Sand, Reservoir "B"	8950	17.0	1.3	303	34.5	112	1669	22.1	1.102	32.0	28	3	50.43	3	1	29.0	0.01
Shell	South Pass Block 27	"M2" Reservoir B Sand Unit	6280	8.9	0.3	142	25.0	155	500	14.4	0.463	33.0	32	4	23.60	5	0	1.8	0.00
Shell	South Pass Block 27	Reservoir "A" "L2" Sand Unit	6420	30.2	1.1	992	25.6	153	500	20.1	0.324	33.4	33	3	24.01	18	0	6.3	-0.04

Table 4: Summary of the sensitivity analysis for ranking of candidate reservoirs for CO2 miscible displacement in Louisiana

Parameter	Spacing, Onshore/Offshore				Discount Rate			Oil Price, $/Bbl			CO2 Price, $/Mcf		
	20/40	40/40	40/80	80/160	12%	15%	20%	15	17	20	0.6	0.8	1.0
Attractive Reservoirs	5	8	39	73	41	39	27	28	39	47	39	32	27
Potential Oil, MMBbls	6.9	24.5	70.6	110.4	74.6	70.6	39.7	40.3	70.6	86.3	70.6	63.3	39.6

Table 5: Reservoir and simulation parameters. Eden field

RESERVOIR PARAMETERS

OOIP, MMBls	11.723
Permeability, md	1910
Temperature, F	205
Dip angle, o	10
Gravity, API	35.2
MMP, psi	3500
Dykstra- Parsons	0.75
C5+ MW	230.3
Swc, %	14
Rs, scf/stb	900
Oil viscosity, cp	0.35
Bo, rb/stb	1.4
Gas gravity	0.7
Water viscosity, cp	0.8
Salinity, ppm	100000
Mixing Parameter	0.6666
Area, sf	3841632
Thickness, ft	139.5
Porosity, %	20
Kh/Kv	0.1

SIMULATION PARAMETERS

RELATIVE PERMEABILITIES

Layers	3
Pattern	Custom
Krocw	1
Kwro	0.116
Krsmax	0.477
Krgcw	0.477
Nw	2
Now	2
Ns	2
Ng	2
Nog	2
Sorw	0.3
Sorg	0.3
Sorm	0.05
Sgr	0.3
Ssr	0.3

SIMULATION RUNS

WF & CO2 HYBRID

Pre- wf pres, psi	3335
Pre -wf So, %	0.517
Water inj, hcpv	0.7
CO2 slug, hcpv	0.125
WAG (CO2 hcpv)	0.3
WAG ratio (vol)	2
Chase water, hcpv	0.3
Qw inj. bpd/w	1000
QCO2, MMscf/d/w	6.2 & 8.0

WATERFLOODING

Pre- wf pres, psi	1484
Pre -wf So, %	0.517
Water inj, hcpv	1.25
Qw inj, bpd/well	1000

INITIAL CO2 HYBRID

Pre-co2 pres, psi	3335
Pre-co2 So, %	0.517

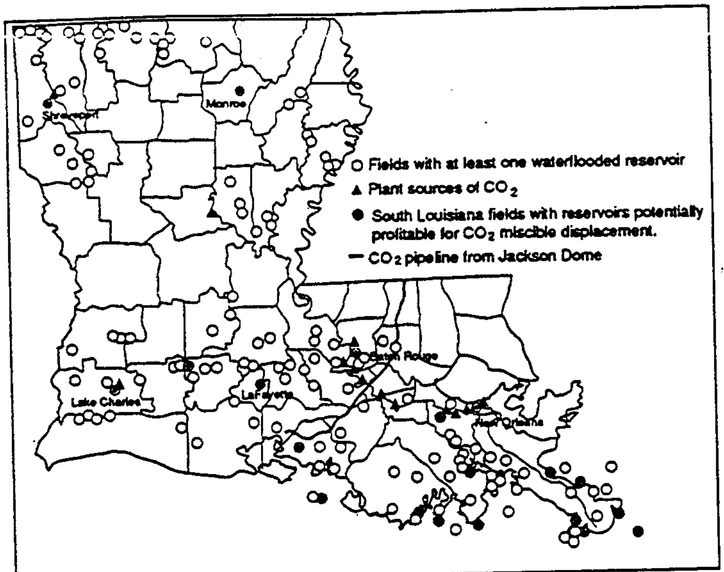


Figure 1. Potential candidates for CO_2 miscible displacement in Louisiana

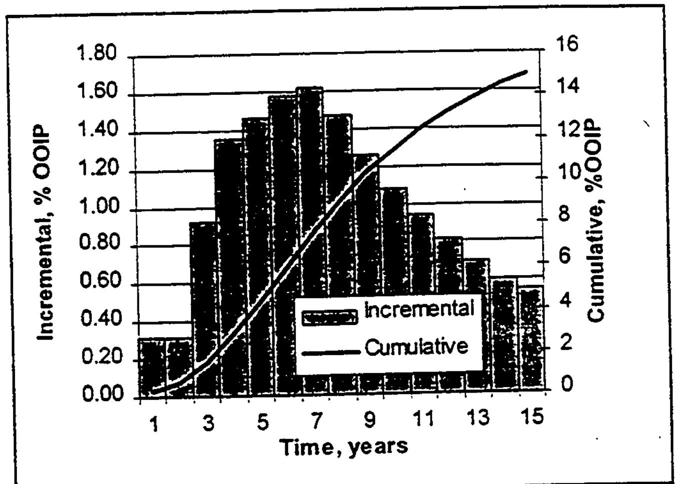


Figure 2. Typical production schedule for CO_2 miscible displacement

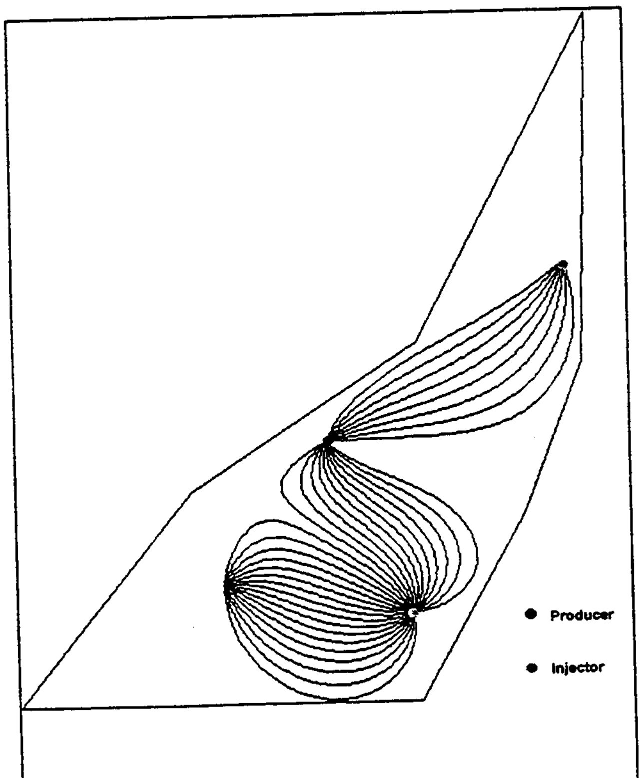


Figure 3. Streamline model for simulation of CO_2 miscible displacement at Eden reservoir

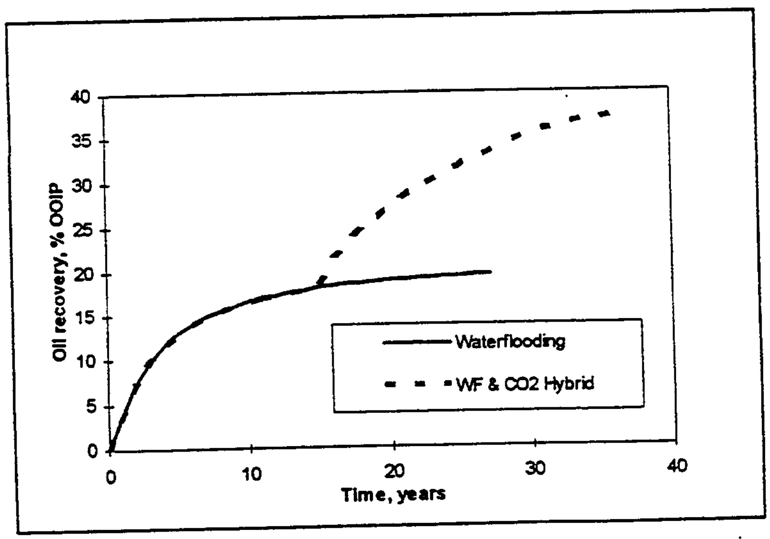


Figure 4. Comparison of alternatives of development for Eden reservoir

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Second Quarter, 1997

Executive Summary

Only two wells remain on production in the Port Neches CO_2 project; Kuhn #38 and Kuhn #14. Production from this project is approaching economic limit and the project is nearing termination at this point. Kuhn #38 performance improved recently when the well tested over 100 BOPD for a short period when the well sanded up due to gravel pack failure. All produced CO_2 is currently being reinjected in the reservoir. The CO_2 recycled volume is dropping below 2 MMCFD, enabling us to operate a single compressor.

Second Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project economics.

No change in project operation since the first quarter report. The project will be uneconomical to operate if the workover on Kuhn #38 fails to restore production.

Discussion of Results - Field Operations

The following is a list of the most recent well test taken during the month of March 1997, for the producing and injection wells:

Producer:	Kuhn #14,	44 BOPD,	96 % BS&W,	580 PSI,	36 CK.
	Kuhn #38,	115 BOPD,	91 % BS&W,	500 PSI,	24 CK.

Injection: 1,756 MCFD of produced gas is being reinjected.

The Financial Status Report, Management Summary, Milestone Schedule and Federal Transaction Report are included in this report.

Discussion of Results - Technology Transfer

No technology transfer activities is taking place during this period.

Third Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project termination.

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	Apr 1, 1997 - Jun 30, 1997	DE-FC22-93BC14960

4. PARTICIPANT NAME AND ADDRESS	5. START DATE / 6. COMPLETION DATE
Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130	5. START DATE: June 1, 1993 6. COMPLETION DATE: December 31, 1997

9. DURATION: 1993 (1Q–4Q), 1994 (1Q–4Q), 1995 (1Q–4Q), 1996 (1Q–4Q), CURRENT FISCAL YEAR 1997 (1Q–4Q)

7. ELEMENT CODE	8. REPORTING ELEMENT	9. DURATION (milestones)	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering	1	100%	100%
1.2	Extraction Technology	2	100%	100%
2.1	Recording Daily Production	3, A	50%	50%
2.2	Reservoir Charac-terization	4, B, C	100%	100%
2.3	Site Operation & Field Work	D, E, F	100%	100%
2.4	CO2	6	50%	50%
2.5	EH&S Monitoring & Compliance	G, H, 7, I	50%	50%
3.1	CO2 Screening Model	J, 8	100%	100%
3.2	Environmental Analysis	9	100%	100%
3.3	FDD Database & Model	K, 10	100%	100%
3.4	Technical Publications	L, 11	50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

Timothy L. Tipton
1/12/98

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY

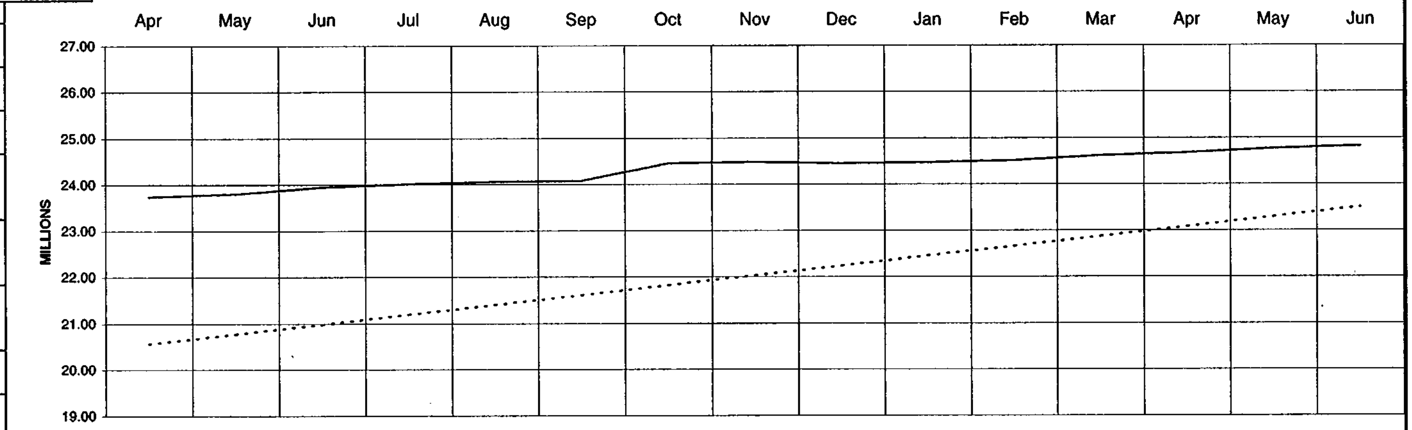
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER DE - FC22 - 93BC14960	2. PROGRAM/PROJECT TITLE CLASS I	3. REPORTING PERIOD 4/1/97 through 6/30/97
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration & Production Inc 400 Poydras St. New Orleans, LA 70130	5. START DATE: 6/1/93 6. COMPLETION DATE: 12/31/97	
7. FY	8. MONTHS	

9. COST STATUS

- a. $ Expressed in: THOUSANDS
- b. Budget and Reporting No. AC1510100
- c. Cost Plan Date 6/23/93
- d. Actual Costs Prior Years 23,686
- e. Planned Costs Prior Years 20,356
- f. Total Estimated Costs for Contract 10,085
- g. Total Contract Value 2,985
- h. Estimated Subsequent Reporting Period

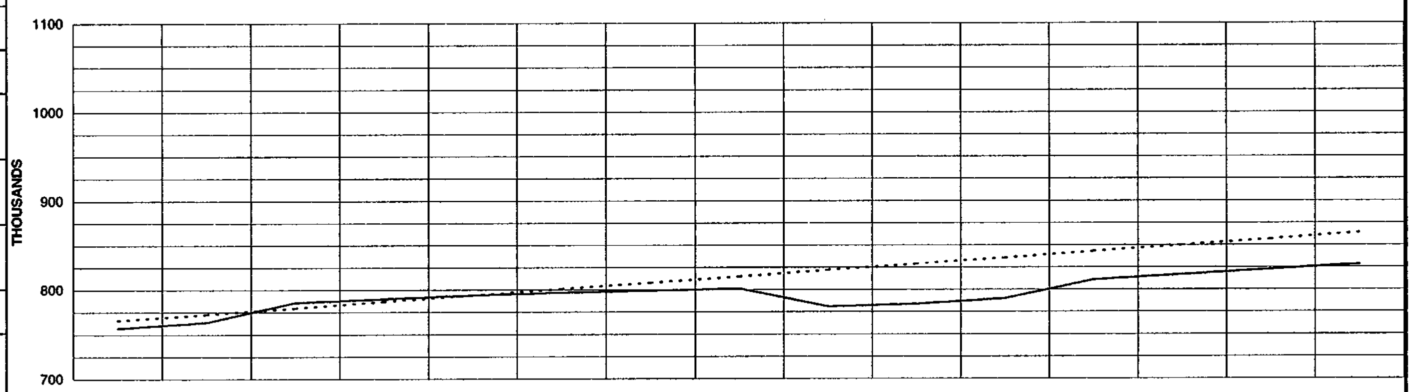


Accrued Costs	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
h. Actual	56	61	148	61	46	23	377	26	(34)	17	46	100	62	95	51
i. Variance	154	149	62	149	164	187	(167)	184	244	193	164	110	148	115	159
j. Cumulative Variance	(403)	(254)	(192)	(43)	121	308	141	325	569	762	926	1,036	1,184	1,299	1,458

10. LABOR STATUS

- a. Labor Expressed in: THOUSANDS
- b. Labor Plan Date: N/A DIRECT LABOR
- c. Planned Labor Prior Fiscal Years 759
- d. Actual Labor Prior Fiscal Years 752
- e. Total Estimated Labor for Contract 465
- f. Total Contract Labor N/A

LEGEND
Planned: ....
Actual: ------------------
Projected: ....



Labor	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
h. Actual	5	7	22	4	4	3	2	2	(20)	3	6	21	6	6	6
i. Variance	2	0	(15)	3	3	4	5	5	27	4	1	(14)	1	1	1
j. Cumulative Variance	5	5	(10)	(7)	(4)	0	5	10	37	41	42	28	29	31	32

11. MILESTONES

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE Post Waterflood CO_2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	2. REPORTING PERIOD Apr 1, 1997 - Jun 30, 1997	3. IDENTIFICATION NUMBER DE-FC22-93BC14960
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130		5. START DATE June 1, 1993 6. COMPLETION DATE December 31, 1997

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE
Timothy L. Tipton 08/18/97

2/25/98

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted **U. S. Department of Energy**	2. Federal Grant or Other Identifying Number Assigned By Federal Agency **DE-FC22-93BC14960**	OMB Approval No. 0348-0039	Page **1**	of **1 pages**

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number **51-0265713**	5. Recipient Account Number or Identifying Number **323037151**	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual
8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) **January 1, 1995**	To: (Month, Day, Year) **December 31, 1997**	9. Period Covered by this Report From: (Month, Day, Year) **04-01-97**	To: (Month, Day, Year) **06-30-97**

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$4,012,955.58	$208,356.30	$4,221,311.88
b. Recipient share of outlays (64.39%)	$2,583,942.10	$134,160.62	$2,718,102.72
c. Federal share of outlays (35.61%)	$1,429,013.48	$74,195.68	$1,503,209.16
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$1,429,013.48	$74,195.68	$1,503,209.16
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,555,585.52	($74,195.68)	$1,481,389.84

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional [ ] Predetermined [Final [ ] Fixed			
	b. Rate 78.62%	c. Base $17,106.53	d. Total Amount $13,449.15	e. Federal Share $4,789.24

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title **Timothy L Tipton - Project Manager**	Telephone (Area code, number and extension) **(504) 595-1728**
Signature of Authorized Certifying Official	Date Report Submitted

Standard Form 269A (REV 4-88)

Previous Editions not Usable

Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted: **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **00 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

3. FEDERAL EMPLOYER IDENTIFICATION NO> **51-0265713**

4. Federal grant or other identification number	5. Recipient's account number or identifying number
DE-FC22-93BC14960	323037151
6. Letter of credit number	7. Last payment voucher number
NA	-

Give total number for this period

8. Payment Vouchers credited to your account	9. Treasury checks received (whether or not deposited)
-	0

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year)	TO (month,day,year)
04/01/97	06/30/97

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$0.00
	d. Total receipts (Sum of lines b and c)	$0.00
	e. Total cash available (Sum of lines a and d)	$0.00
	f. Gross disbursements	$0.00
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$0.00
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED
	TYPED OR PRINTED NAME AND TITLE: **Tim Tipton - Project Manager**	TELEPHONE (Area Code, Number, Extension): **(504) 595-1728**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)

Prescribed by Office of Management and Budget

Cir. No. A-110

DOE F 1430.22
(04-91)
All other editions
are obsolete

OMB Control No.
1910-1400
Burden Disclosure
Statement on Back

U. S. DEPARTMENT OF ENERGY
NOTICE OF ENERGY RD&D PROJECT

1. DOE CONTRACT OR GRANT NUMBER DE-FC22-93BC14960

☐ New contract ☒ Continuation/Revision

2. A. NAME OF PERFORMING ORGANIZATION Texaco E&P Inc.
   B. Department or Division Onshore Division
   C. Street Address 400 Poydras
   City New Orleans State LA. Zip 70130

   D. Type of Performing Organization (circle only one two-letter code)
   CU - College,university,trade school
   EG - Electric or gas utility
   FF - Federally funded RD&D centers or laboratory operated for agency of US government
   IN - Private industry
   NP - Foundation or laboratory not operated for profit
   ST - Regional, state or local government facility
   TA - Trade or professional organization
   US - Federal agency
   XX - Other

3. PRINCIPAL OR SENIOR INVESTIGATOR
   A. Last Tipton First Timothy MI L
   B. Phone: Commercial (504) 680-1728 FTS

4. DOE SPONSORING OFFICE OR DIVISION Bartlesville Office

5. TITLE OF PROJECT Post Waterflood CO_2 Miscible Flood In Light Oil Fluvial Dominated Deltaic Reservoir

6. DESCRIPTIVE SUMMARY (limit to 200 words)

The Port Neches CO_2 flood is a joint project between the department of energy (DOE) and Texaco E&P Inc. (TEPI) that has been in operations for nearly 3 years. This project represents a learning step in developing the CO_2 technology. Initially, it was estimated that the project will recover 2.2 MMSTB of incremental oil, or 19% of the OOIP. The project design was based on a reservoir model and other classical reservoir engineering calculations utilizing the OOIP as a basis to estimate the remaining tertiary reserves. The Port Neches flood has produced 300 MSTB of tertiary oil to date. The production peaked at 500 BOPD in October of 1994 as indicated in Fig. 3. This was below the anticipated 800 BOPD rate initially predicted by the model. The reservoir under-performance is attributed to the following reasons: Reservoir characterization, oil saturation, water blockage and wellbore mechanical problems. Detailed information is included in appendix B of the 1996 Annual Report.

7. RESPONDENT INFORMATION List name and address of person filling out this form. Give telephone number and extension where person can be reached. Record the date this form was completed or updated. This information will not be published.

Last Tipton First Timothy MI L
Address 400 Poydras Street
City New Orleans State LA Zip 70130
Phone (504) 680-1728 Date August 18, 1997

INSTRUCTIONS
NOTICE OF ENERGY RD&D PROJECT

Notice
If in the past six months you have completed a Statement of Work (SOW) or brief project description for DOE, complete only the additional data elements on this form and send it and a copy of the completed SOW or description to U.S. Department of Energy, Office of Scientific and Technical Information, Post Office Box 62 Oak Ridge, TN 37831.

1. CONTRACT OR GRANT NUMBER
The DOE contract or GRANT number under which the work is being performed. Check correct block for new contract or revision/continuation of prior contract.

2. A. NAME OF PERFORMING ORGANIZATION
Provide company or institution name of the organization doing the work.

   B. DEPARTMENT OR DIVISION
   List the department or division of the performing organization

   C. MAILING ADDRESS
   Provide the complete mailing address

   D. TYPE OF PERFORMING ORGANIZATION (circle only one two letter code)
   CU EG FF IN NP ST TA US XX

3. PRINCIPAL OR SENIOR INVESTIGATOR
   A. Name of person chiefly responsible for the performance of the project.
   B. Give telephone number,including area code,and if you have an FTS number,please include it.

4. DOE SPONSORING OFFICE OR DIVISION
List the DOE organization that is funding the work.

5. TITLE OF PROJECT
Be as specific as possible. Use words that are descriptive of the work done.

6. DESCRIPTIVE SUMMARY
Include objectives, approach, and expected results. Quantify where possible.

7. RESPONDENT INFORMATION
List name and address of person filling out this form. Give telephone number and extension where person can be reached. Record the date this form was completed or updated. This information will not be published.

OMB Disclosure Statement

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Third Quarter, 1997

Executive Summary

Only one well remains on production in the Port Neches CO_2 project; Kuhn #14. Production from this project is approaching economic limit and the project is nearing termination at this point. The workover to return Kuhn #38 to production failed and the well is currently shut in. All produced CO_2 is currently being reinjected in the reservoir. The CO_2 recycled volume is 2 MMCFD.

Third Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project economics.

No change in project operation since the second quarter report. The project is at a negative cash flow because of the workover failure at Kuhn #38.

Discussion of Results - Field Operations

The following is a list of the most recent well test taken during the month of June 1997, for the producing and injection wells:

Producer:	Kuhn #14,	18 BOPD,	98 % BS&W,	400 PSI,	36 CK.
Injection:	2,008 MCFD of produced gas is being reinjected.				

The Financial Status Report, Management Summary, Milestone Schedule and Federal Transaction Report are included in this report.

Discussion of Results - Technology Transfer

No technology transfer activities is taking place during this period.

Fourth Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project termination.

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir

2. REPORTING PERIOD
Jul 1, 1997 - Sept 30, 1997

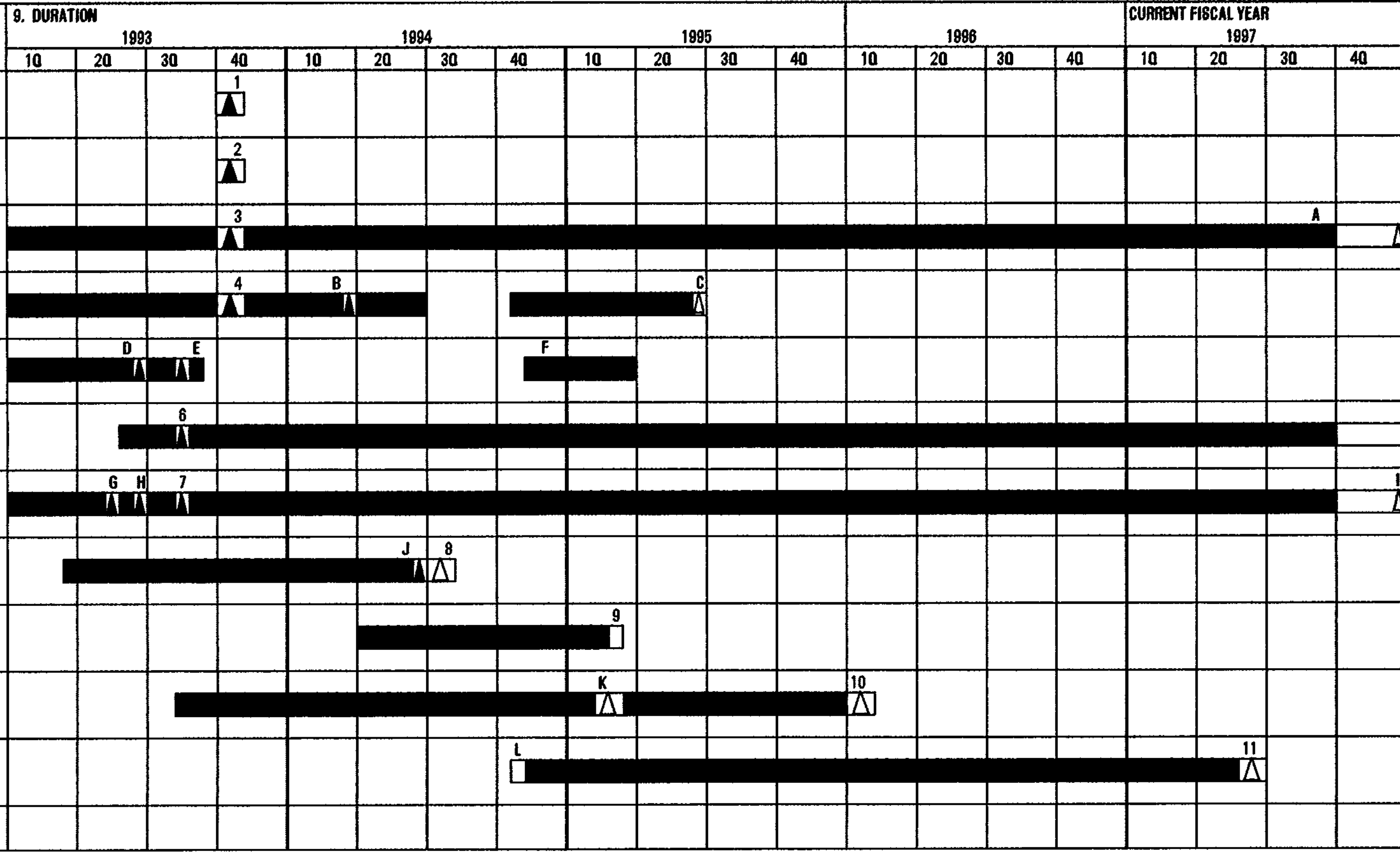
3. IDENTIFICATION NUMBER
DE-FC22-93BC14960

4. PARTICIPANT NAME AND ADDRESS
Texaco Exploration and Production Inc.
400 Poydras St.
New Orleans, LA 70130

5. START DATE
June 1, 1993

6. COMPLETION DATE
December 31, 1997

9. DURATION



7. ELEMENT CODE	8. REPORTING ELEMENT	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering	100%	100%
1.2	Extraction Technology	100%	100%
2.1	Recording Daily Production	75%	75%
2.2	Reservoir Charac-terization	100%	100%
2.3	Site Operation & Field Work	100%	100%
2.4	CO2	75%	75%
2.5	EH&S Monitoring & Compliance	75%	75%
3.1	CO2 Screening Model	100%	100%
3.2	Environmental Analysis	100%	100%
3.3	FDD Database & Model	100%	100%
3.4	Technical Publications	100%	100%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE
Timothy L. Tipton
1/13/98

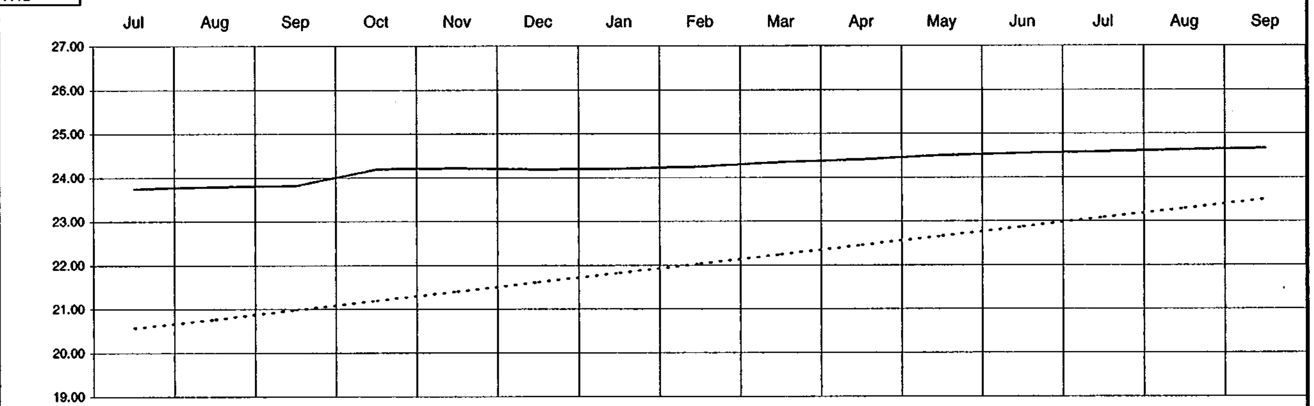
DOE F1332.2
(11-84)

U. S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

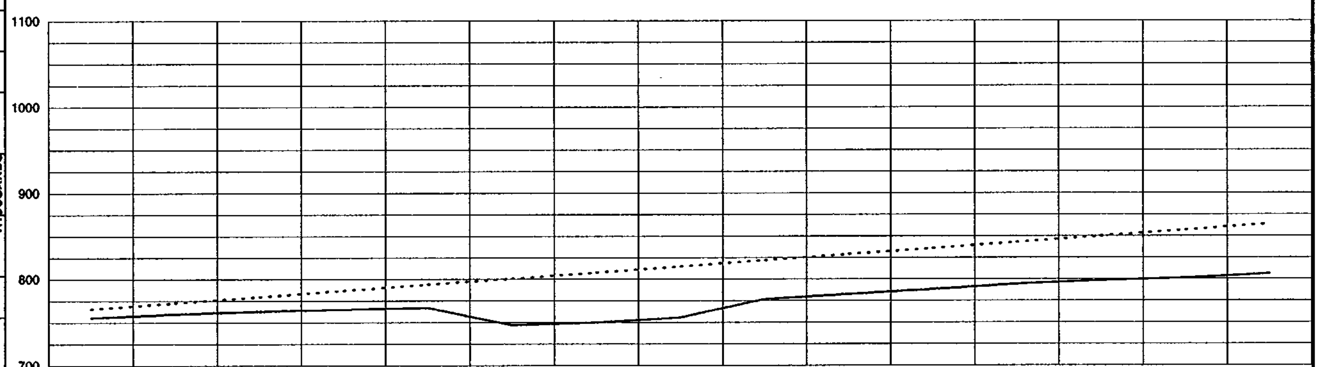
1. IDENTIFICATION NUMBER DE - FC22 - 93BC14960	2. PROGRAM/PROJECT TITLE CLASS I	3. REPORTING PERIOD 7/1/97 through 9/30/97
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration & Production Inc 400 Poydras St. New Orleans, LA 70130	5. START DATE: 6/1/93 6. COMPLETION DATE: 12/31/97	
7. FY	8. MONTHS	

9. COST STATUS
a. $ Expressed in: THOUSANDS
b. Budget and Reporting No. AC1510100
c. Cost Plan Date 6/23/93
d. Actual Costs Prior Years 23,686
e. Planned Costs Prior Years 20,356
f. Total Estimated Costs for Contract 10,085
g. Total Contract Value 2,985
h. Estimated Subsequent Reporting Period



Accrued Costs	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
h. Actual	61	46	23	377	26	(34)	17	46	100	62	95	51	30	47	27
i. Variance	149	164	187	(167)	184	244	193	164	110	148	115	159	180	163	183
j. Cumulative Variance	(403)	(239)	(52)	(219)	(35)	209	402	566	676	824	939	1,098	1,278	1,441	1,623

10. LABOR STATUS
a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A DIRECT LABOR
c. Planned Labor Prior Fiscal Years 759
d. Actual Labor Prior Fiscal Years 752
e. Total Estimated Labor for Contract 465
f. Total Contract Labor N/A
LEGEND
Planned: - - - - - - - - - -
Actual: ————————
Projected: . . . .



Labor	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
h. Actual	4	4	3	2	2	(20)	3	6	21	6	6	6	4	3	5
i. Variance	3	3	4	5	5	27	4	1	(14)	1	1	1	3	4	2
j. Cumulative Variance	5	8	12	17	22	49	53	54	40	41	43	44	47	51	53

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	**Jul 1, 1997 - Sept 30, 1997**	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	CANCELLED

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

Timothy L. Tipton 1/13/98

123/1332A96.WK4

1/13/98

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted **U. S. Department of Energy**	2. Federal Grant or Other Identifying Number Assigned By Federal Agency **DE-FC22-93BC14960**	OMB Approval No. 0348-0039	Page 1	of 1 pages
3. Reciepient Organization (Name and complete address, including ZIP code) **Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130**				
4. Employer Identification Number **51-0265713**	5. Recipient Account Number or Identifying Number **323037151**	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual	
8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) **January 1, 1995**	To: (Month, Day, Year) **December 31, 1997**	9. Period Covered by this Report From: (Month, Day, Year) **07-01-97**	To: (Month, Day, Year) **09-30-97**	

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$4,221,311.88	$104,513.33	$4,325,825.21
b. Recipient share of outlays (64.39%)	$2,718,102.72	$67,296.13	$2,785,398.85
c. Federal share of outlays (35.61%)	$1,503,209.16	$37,217.20	$1,540,426.36
d. Total unliquidated obligations	[redacted]	[redacted]	[redacted]
e. Recipient share of unliquidated obligations	[redacted]	[redacted]	[redacted]
f. Federal share of unliquidated obligations	[redacted]	[redacted]	[redacted]
g. Total Federal share (Sum of lines c and f)	$1,503,209.16	$37,217.20	$1,540,426.36
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,481,389.84	($37,217.20)	$1,444,172.64

11. Indirect Expense **(Labor)**	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 78.62%	c. Base $11,798.69	d. Total Amount $9,276.13	e. Federal Share $3,303.23

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title **Timothy L. Tipton - Project Manager**	Telephone (Area code, number and extension) **(504) 680-1728**
Signature of Authorized Certifying Official *Timothy L. Tipton*	Date Report Submitted **1/12/98**

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

Previous Editions not Usable

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **00 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

4. Federal grant or other identification number: **DE-FC22-93BC14960**

5. Recipient's account number or identifying number: **323037151**

6. Letter of credit number: **NA**

7. Last payment voucher number: -

Give total number for this period

8. Payment Vouchers credited to your account: -

9. Treasury checks received (whether or not deposited): **0**

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year): **07/01/97** TO (month,day,year): **09/30/97**

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$0.00
	d. Total receipts (Sum of lines b and c)	$0.00
	e. Total cash available (Sum of lines a and d)	$0.00
	f. Gross disbursements	$0.00
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$0.00
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE: *Timothy L. Tipton*	DATE REPORT SUBMITTED: 1/13/98
	TYPED OR PRINTED NAME AND TITLE: Timothy L.Tipton - Project Manager	TELEPHONE (Area Code, Number, Extension): (504) 680-1728

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)

Prescribed by Office of Management and Budget

Cir. No. A-110

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Fourth Quarter, 1997

Executive Summary

Only one well remains on production in the Port Neches CO_2 project; Kuhn #14. Production from this project is approaching economic limit and the project is nearing termination at this point. The workover to return Kuhn #38 to production failed and the well is currently shut in. All produced CO_2 is currently being reinjected in the reservoir. The CO_2 recycled volume is 2 MMCFD.

Fourth* Quarter 1997, Objectives

* Monitor reservoir performance, and evaluate the project economics.

No change in project operation since the second quarter report. The project is at a negative cash flow because of the workover failure at Kuhn #38.

Discussion of Results - Field Operations

The following is a list of the most recent well test taken during the month of September 1997, for the producing and injection wells:

Producer:	Kuhn #14,	33 BOPD,	96 % BS&W,	420 PSI,	36 CK.

Injection: No produced gas is being reinjected during September in preparation of project termination.

Final allocated production, Reservoir yield, reservoir voidage, and wells' performance plots are included in this report.

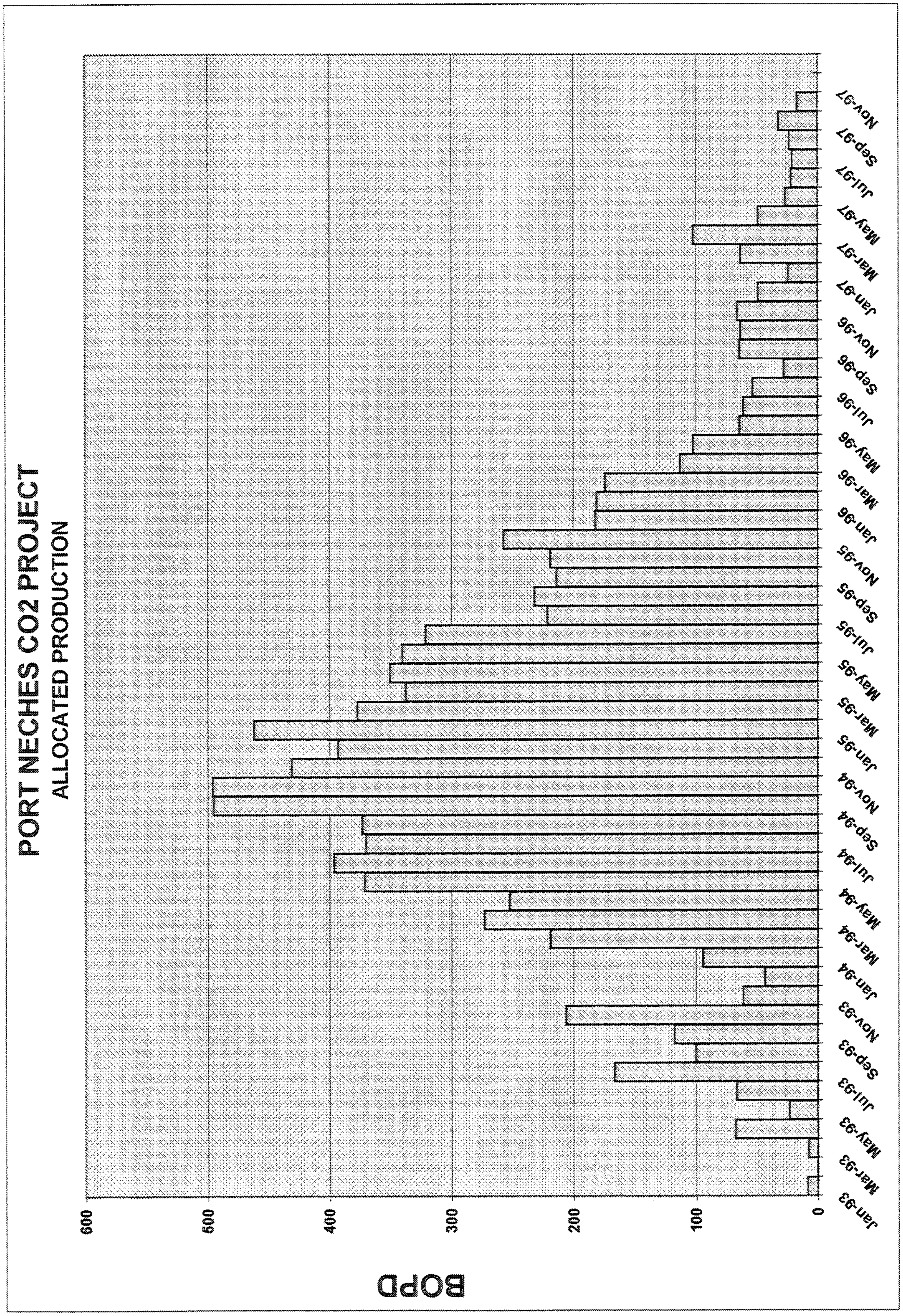
The Financial Status Report, Management Summary, Milestone Schedule and Federal Transaction Report are included in this report.

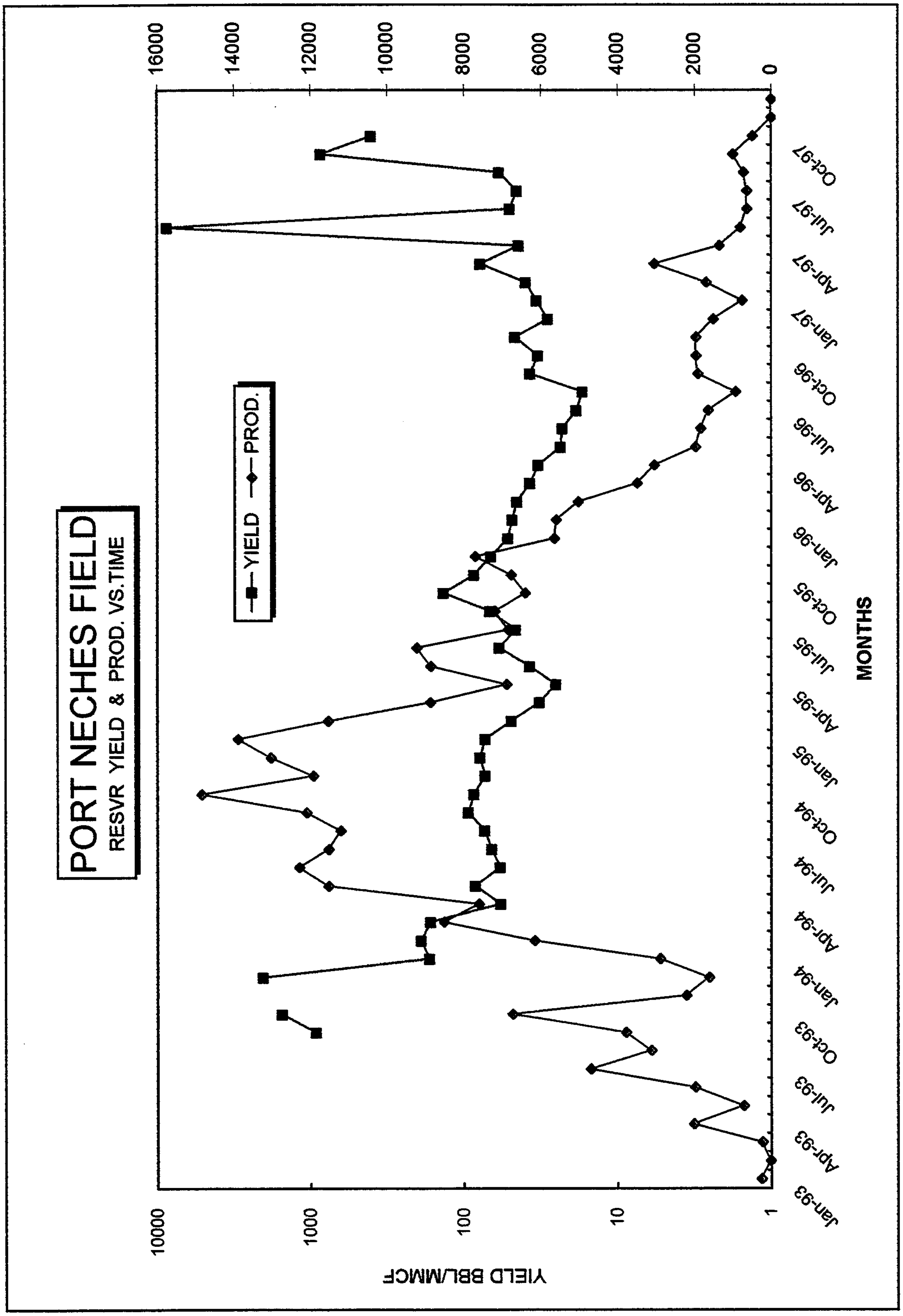
<u>Discussion of Results - Technology Transfer</u>

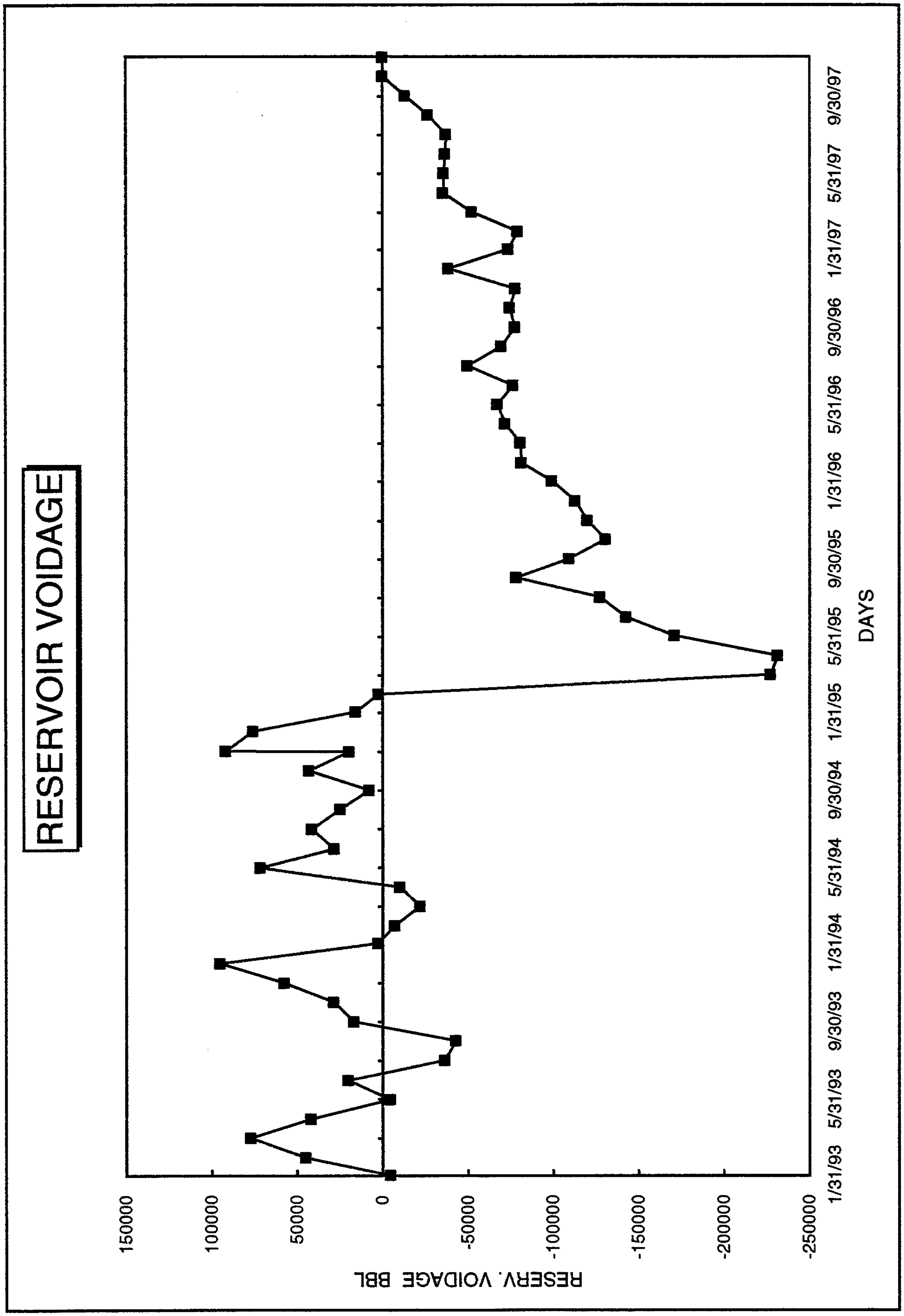
No technology transfer activities is taking place during this period.

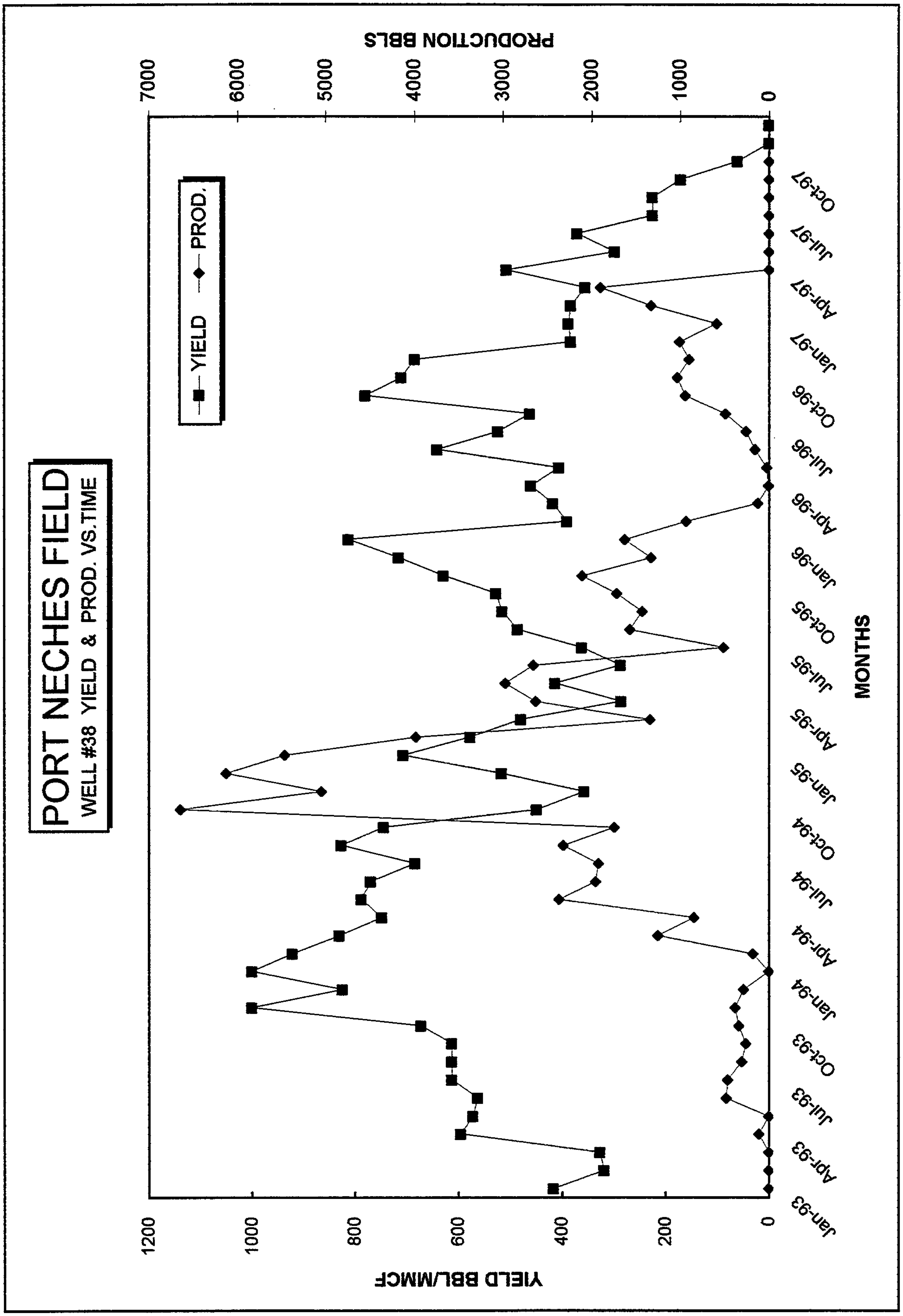
<u>First Quarter 1998, Objectives</u>

* Monitor reservoir performance, and begin project termination.

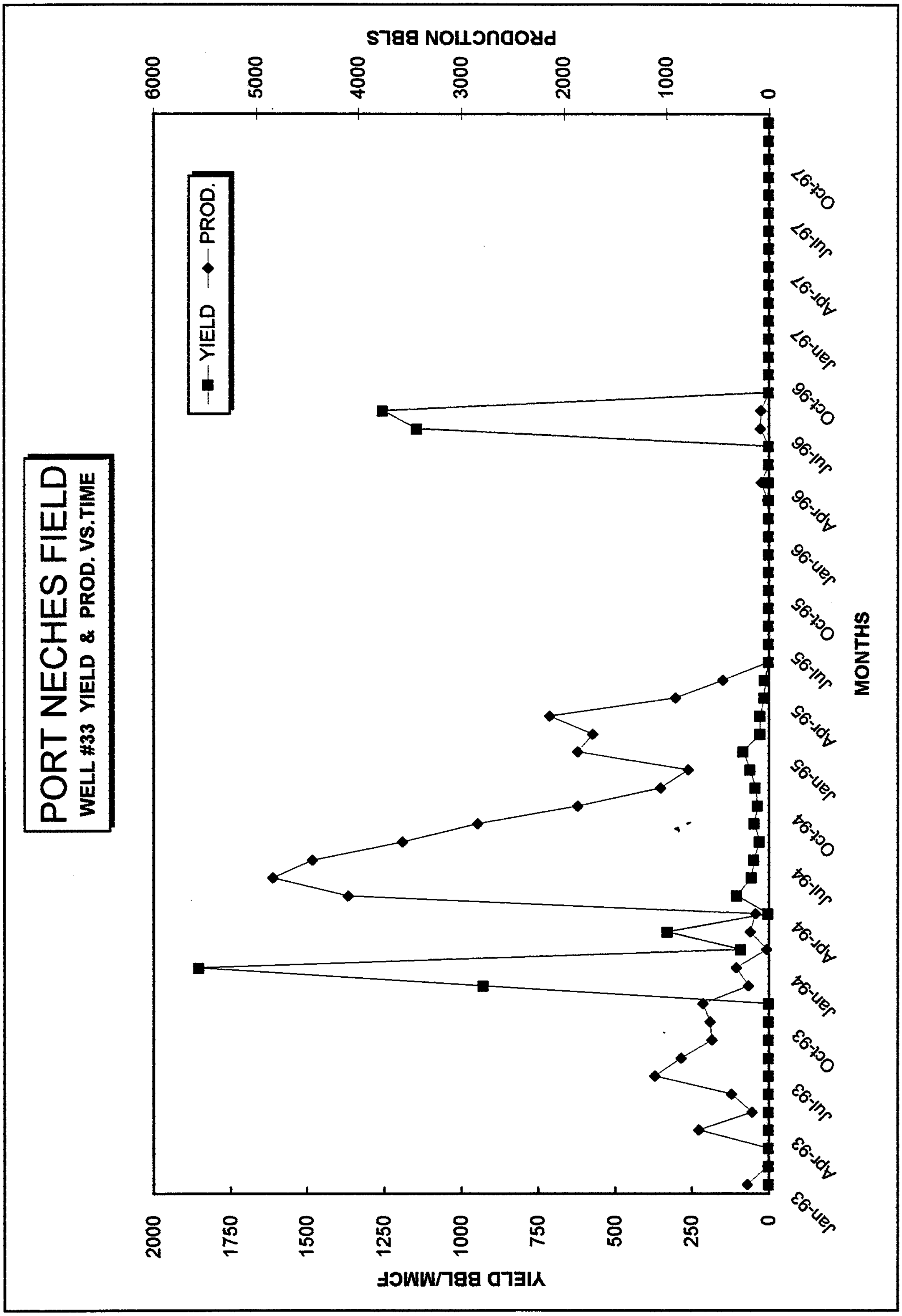

PORT NECHES CO2 PROJECT
ALLOCATED PRODUCTION
BOPD
0
100
200
300
400
500
600
Jan-93
Mar-93
May-93
Jul-93
Sep-93
Nov-93
Jan-94
Mar-94
May-94
Jul-94
Sep-94
Nov-94
Jan-95
Mar-95
May-95
Jul-95
Sep-95
Nov-95
Jan-96
Mar-96
May-96
Jul-96
Sep-96
Nov-96
Jan-97
Mar-97
May-97
Jul-97
Sep-97
Nov-97

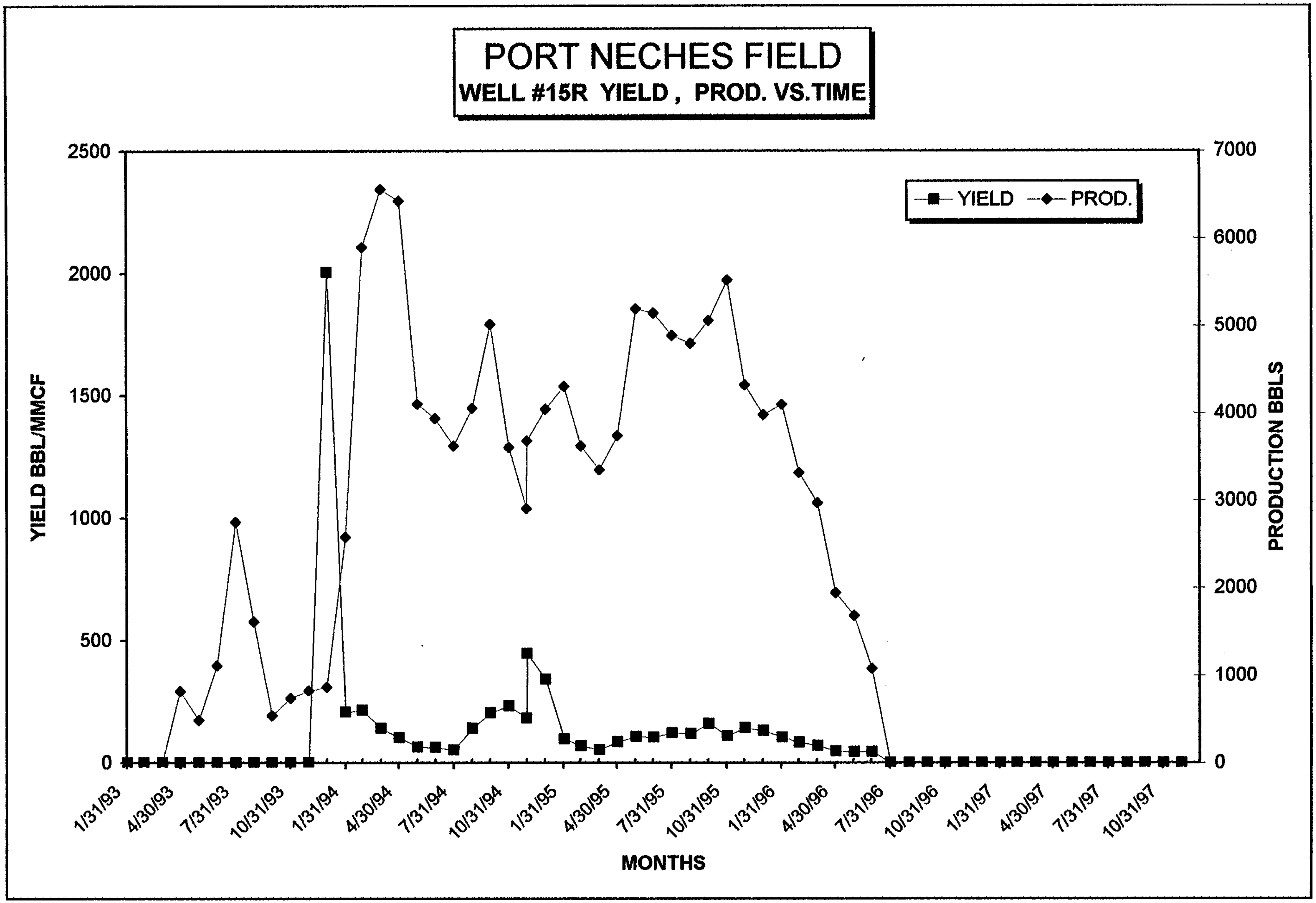

PORT NECHES FIELD
RESVR YIELD & PROD. VS.TIME
YIELD
PROD.
YIELD BBL/MMCF
10000
1000
100
10
1
16000
14000
12000
10000
8000
6000
4000
2000
0
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
MONTHS

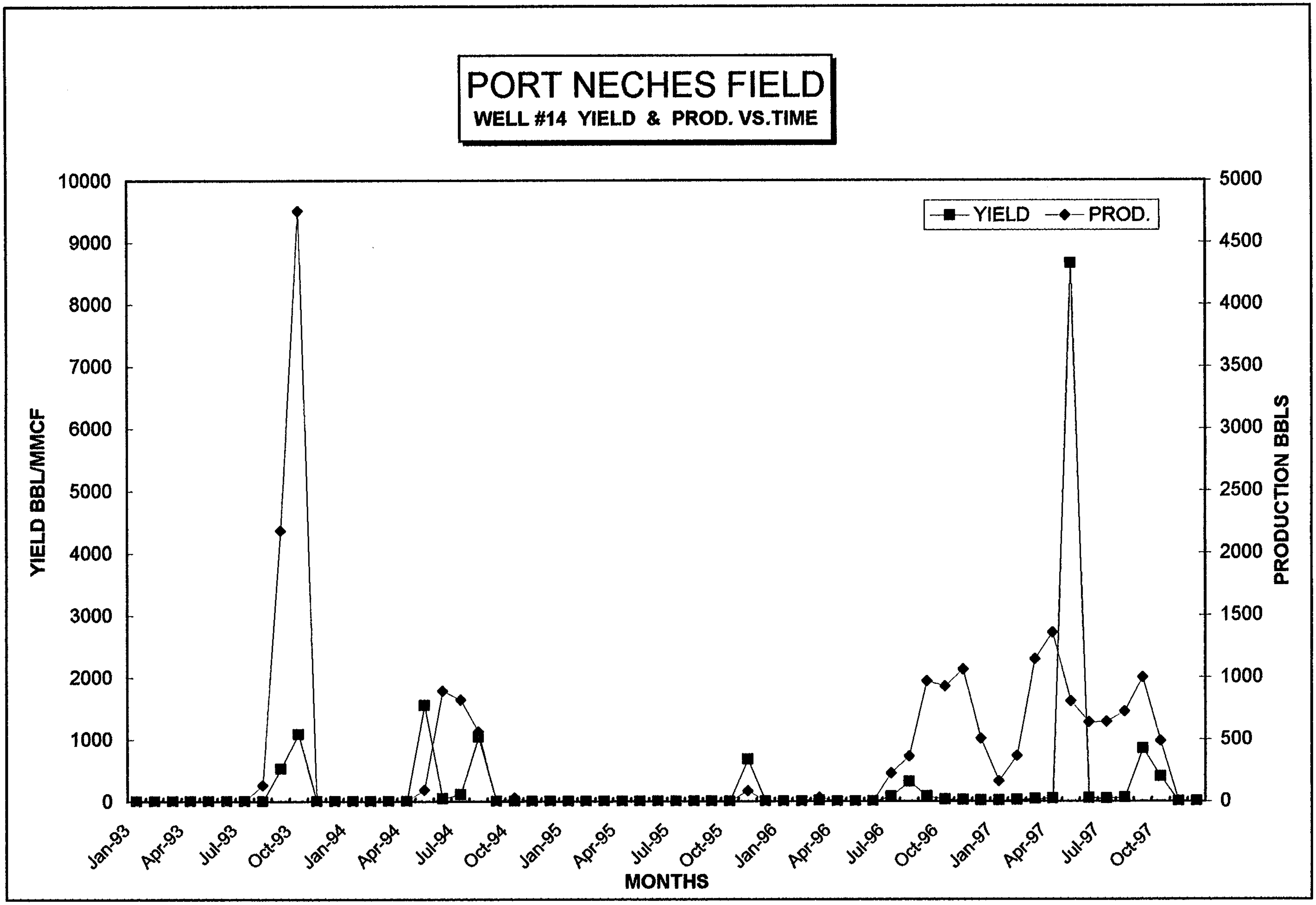

RESERVOIR VOIDAGE
RESERV. VOIDAGE BBL
150000
100000
50000
0
-50000
-100000
-150000
-200000
-250000
1/31/93
5/31/93
9/30/93
1/31/94
5/31/94
9/30/94
1/31/95
5/31/95
9/30/95
1/31/96
5/31/96
9/30/96
1/31/97
5/31/97
9/30/97
DAYS

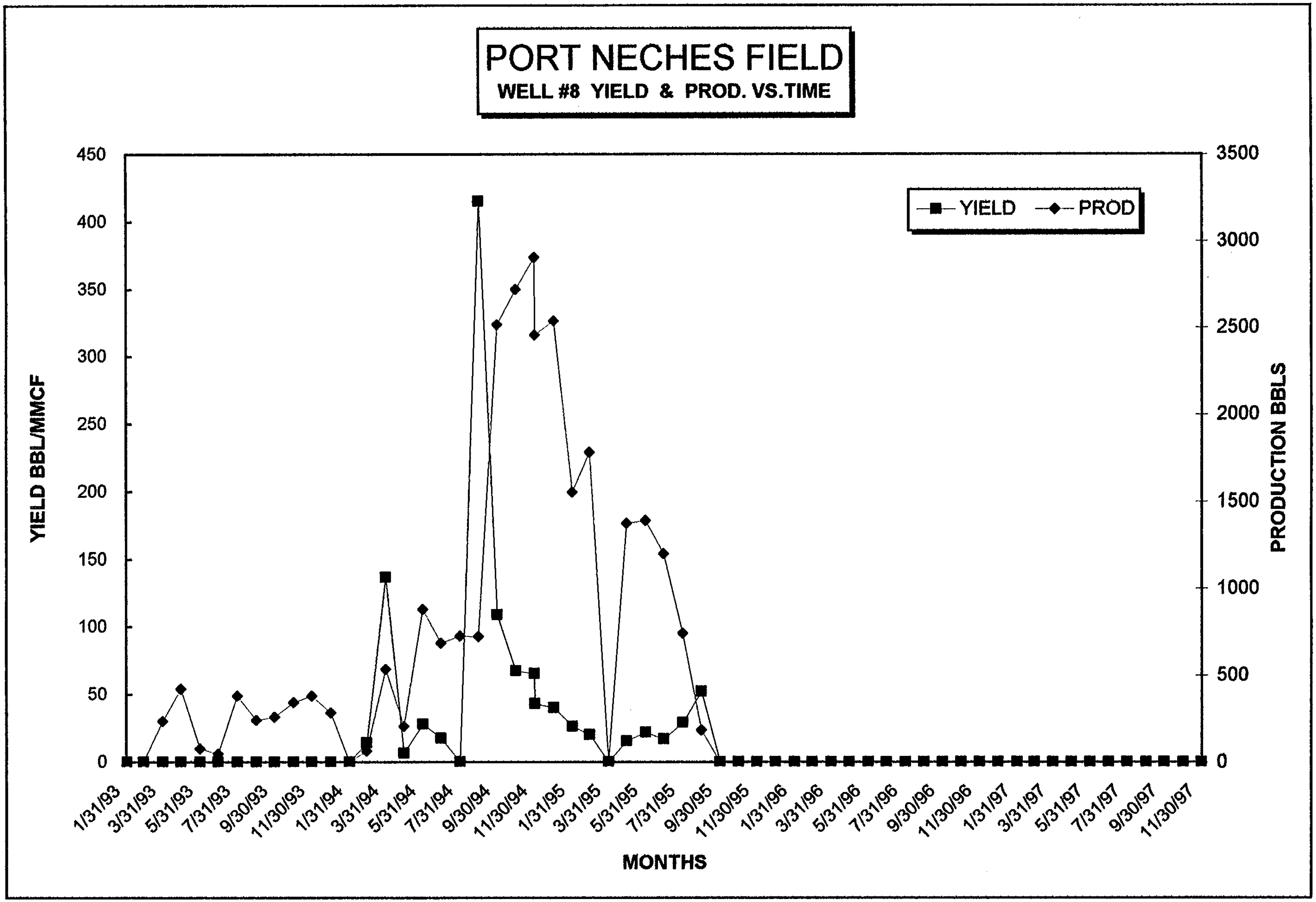


PORT NECHES FIELD
WELL #38 YIELD & PROD. VS.TIME
YIELD
PROD.
YIELD BBL/MMCF
PRODUCTION BBLS
MONTHS
0
200
400
600
800
1000
1200
0
1000
2000
3000
4000
5000
6000
7000
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97


PORT NECHES FIELD
WELL #33 YIELD & PROD. VS.TIME
YIELD
PROD.
YIELD BBL/MMCF
PRODUCTION BBLS
MONTHS
2000
1750
1500
1250
1000
750
500
250
0
6000
5000
4000
3000
2000
1000
0
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97


PORT NECHES FIELD
WELL #15R YIELD , PROD. VS.TIME
YIELD
PROD.
YIELD BBL/MMCF
PRODUCTION BBLS
MONTHS
0
500
1000
1500
2000
2500
0
1000
2000
3000
4000
5000
6000
7000
1/31/93
4/30/93
7/31/93
10/31/93
1/31/94
4/30/94
7/31/94
10/31/94
1/31/95
4/30/95
7/31/95
10/31/95
1/31/96
4/30/96
7/31/96
10/31/96
1/31/97
4/30/97
7/31/97
10/31/97


PORT NECHES FIELD
WELL #14 YIELD & PROD. VS.TIME
YIELD BBL/MMCF
PRODUCTION BBLS
MONTHS
YIELD
PROD.
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
Jan-96
Apr-96
Jul-96
Oct-96
Jan-97
Apr-97
Jul-97
Oct-97
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000


PORT NECHES FIELD
WELL #8 YIELD & PROD. VS.TIME
YIELD
PROD
YIELD BBL/MMCF
PRODUCTION BBLS
MONTHS
0
50
100
150
200
250
300
350
400
450
500
1000
1500
2000
2500
3000
3500
1/31/93
3/31/93
5/31/93
7/31/93
9/30/93
11/30/93
1/31/94
3/31/94
5/31/94
7/31/94
9/30/94
11/30/94
1/31/95
3/31/95
5/31/95
7/31/95
9/30/95
11/30/95
1/31/96
3/31/96
5/31/96
7/31/96
9/30/96
11/30/96
1/31/97
3/31/97
5/31/97
7/31/97
9/30/97
11/30/97

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	**Oct 1, 1997 - Dec 31, 1997**	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTING ELEMENT	9. DURATION (1993 1Q–4Q; 1994 1Q–4Q; 1995 1Q–4Q; 1996 1Q–4Q; CURRENT FISCAL YEAR 1997 1Q–4Q)	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering	1	100%	100%
1.2	Extraction Technology	2	100%	100%
2.1	Recording Daily Production	3, A	100%	100%
2.2	Reservoir Charac-terization	4, B, C	100%	100%
2.3	Site Operation & Field Work	D, E, F	100%	100%
2.4	CO2	6	100%	100%
2.5	EH&S Monitoring & Compliance	G, H, 7, I	100%	100%
3.1	CO2 Screening Model	J, 8	100%	100%
3.2	Environmental Analysis	9	100%	100%
3.3	FDD Database & Model	K, 10	100%	100%
3.4	Technical Publications	L, 11	100%	100%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

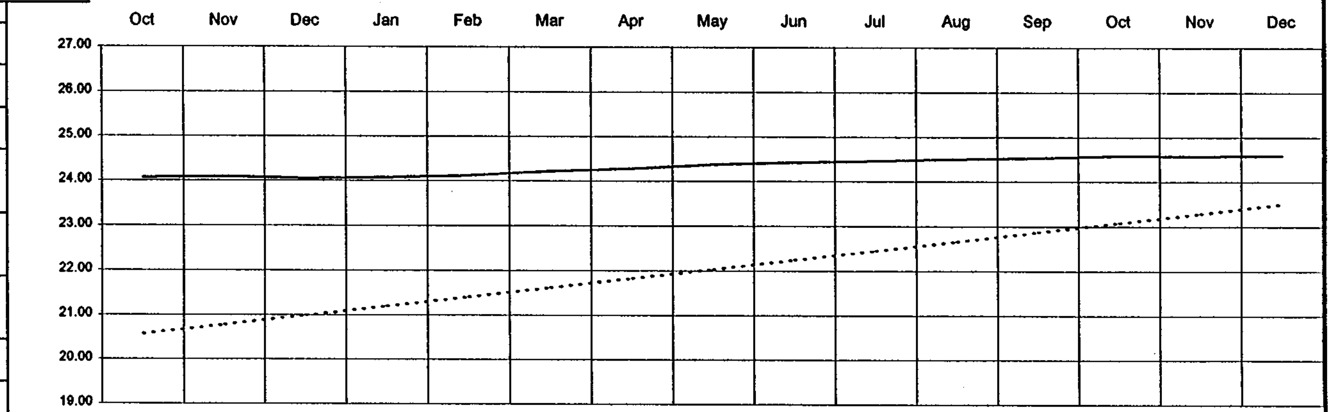
(11-84)

OMB NO. 1901-1400

1. IDENTIFICATION NUMBER DE - FC22 - 93BC14960	2. PROGRAM/PROJECT TITLE CLASS I	3. REPORTING PERIOD 10/1/97 through 12/31/97
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration & Production Inc 400 Poydras St. New Orleans, LA 70130	5. START DATE: 6/1/93 6. COMPLETION DATE: 12/31/97	
7. FY	8. MONTHS	

9. COST STATUS

- a. $ Expressed in: HOUSANDS
- b. Budget and Reporting No. AC1510100
- c. Cost Plan Date 6/23/93
- d. Actual Costs Prior Years 23,686
- e. Planned Costs Prior Years 20,356
- f. Total Estimated Costs for Contract 10,085
- g. Total Contract Value 2,985
- h. Estimated Subsequent Reporting Period

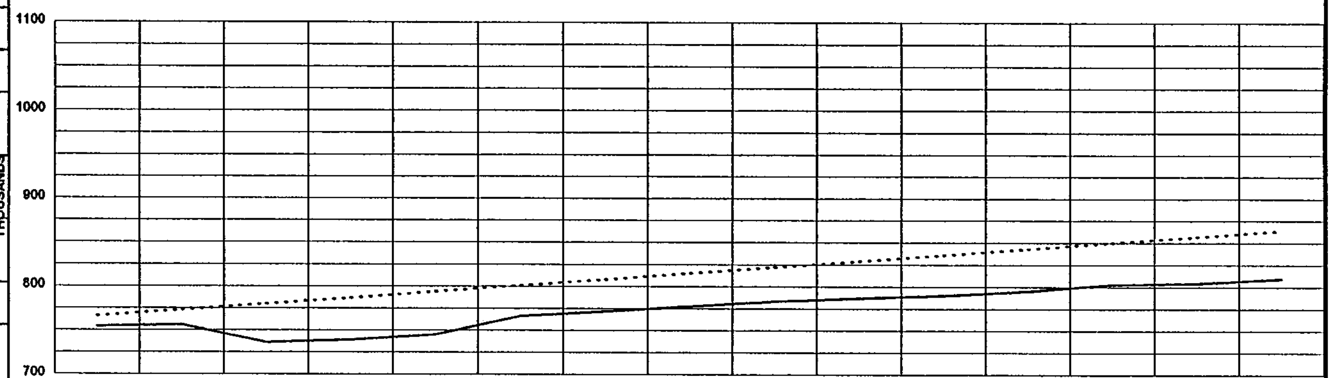


Accrued Costs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
h. Actual	377	26	(34)	17	46	100	62	95	51	30	47	27	53	(11)	17
i. Variance	(167)	184	244	193	164	110	148	115	159	180	163	183	157	221	193
j. Cumulative Variance	(403)	(219)	25	218	382	492	640	755	914	1,094	1,257	1,439	1,596	1,817	2,010

10. LABOR STATUS

- a. Labor Expressed in: THOUSANDS
- b. Labor Plan Date: N/A DIRECT LABOR
- c. Planned Labor Prior Fiscal Years 759
- d. Actual Labor Prior Fiscal Years 752
- e. Total Estimated Labor for Contract 465
- f. Total Contract Labor N/A

LEGEND
Planned: ....
Actual: ————
Projected: ....



Labor	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
h. Actual	2	2	(20)	3	6	21	6	6	6	4	3	5	8	2	5
i. Variance	5	5	27	4	1	(14)	1	1	1	3	4	2	(1)	5	2
j. Cumulative Variance	5	10	37	41	42	28	29	31	32	35	39	41	40	46	48

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

5/8/98

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	2. REPORTING PERIOD Oct 1, 1997 - Dec 31, 1997	3. IDENTIFICATION NUMBER DE-FC22-93BC14960
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130		5. START DATE June 1, 1993 6. COMPLETION DATE December 31, 1997

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	CANCELLED

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	COMPLETED
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE
Timothy R. Tipton 5-13-98

123/1332A96.WK4

5/8/98

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No. 0348-0039	Page	of
U. S. Department of Energy	DE-FC22-93BC14960		1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	323037151	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
January 1, 1995	December 31, 1997	10-01-97	12-31-97

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$4,325,825.21	$59,193.22	$4,385,018.43
b. Recipient share of outlays (64.39%)	$2,785,398.85	$38,114.51	$2,823,513.37
c. Federal share of outlays (35.61%)	$1,540,426.36	$21,078.71	$1,561,505.06
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$1,540,426.36	$21,078.71	$1,561,505.06
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,444,172.64	($21,078.71)	$1,423,093.94

11. Indirect Expense (Labor)

a. Type of Rate (Place "X" in appropriate box)
[X] Provisional [ ] Predetermined [Final [ ] Fixed

b. Rate	c. Base	d. Total Amount	e. Federal Share
78.62%	$14,262.42	$11,213.11	$3,992.99

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Timothy L. Tipton - Project Manager	(504) 680-1728
Signature of Authorized Certifying Official: Timothy L. Tipton	Date Report Submitted: 5-13-98

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

FEDERAL CASH TRANSACTIONS REPORT	Approved by Office of Management and Budget No 80-80182	
(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)	1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**	
2. RECIPIENT ORGANIZATION	4. Federal grant or other identification number **DE-FC22-93BC14960**	5. Recipient's account number or identifying number **323037151**
Name **Texaco Exploration and Production Inc.**	6. Letter of credit number **NA**	7. Last payment voucher number **-**
Number and Street **00 Poydras St.**	*Give total number for this period*	
City, State and Zip Code: **New Orleans, Louisiana 70130**	8. Payment Vouchers credited to your account **-**	9. Treasury checks received (whether or not deposited) **0**
	10. PERIOD COVERED BY THIS REPORT	
3. FEDERAL EMPLOYER IDENTIFICATION NO> **51-0265713**	FROM (month,day,year) **10/01/97**	TO (month,day,year) **12/31/97**

11.STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	**$0.00**
	b. Letter of credit withdrawals	**$0.00**
	c. Treasury check payments	**$0.00**
	d. Total receipts (Sum of lines b and c)	**$0.00**
	e. Total cash available (Sum of lines a and d)	**$0.00**
	f. Gross disbursements	**$0.00**
	g. Federal share of program income	**$0.00**
	h. Net disbursements (Line f minus line g)	**$0.00**
	i. Adjustments of prior periods	**$0.00**
	j. Cash on hand end of period	**$0.00**
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	**$0.00**
	l. Advances to subgrantees or subcontractors	**$0.00**

14. REMARKS

15.	CERTIFICATION	
AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE Timothy L Tipton	DATE REPORT SUBMITTED 5-13-98
	TYPED OR PRINTED NAME AND TITLE **Timothy L. Tipton - Project Manager**	TELEPHONE (Area Code, Number, Extension) **(504) 680-1728**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)

Prescribed by Office of Management and Budget

Cir. No. A-110

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

First Quarter, 1998

Executive Summary

The only remaining active well, Kuhn #14, in the Port Neches CO_2 project went off production in October 1997. Production from this project is reached economic limit and the project termination began in the last quarter of 1997.

First* Quarter 1998, Objectives

* Terminate the project; salvage all useable equipment and plug and abandon all wellbores.

Discussion of Results - Field Operations

Cumulative oil production for 1997 is 11,134 barrels.

Producer:	Kuhn #14,	Off production in October in preparation for project termination.
Injection:	No produced gas is being reinjected during project termination.	

The Financial Status Report, Management Summary, Milestone Schedule and Federal Transaction Report are included in this report.

Discussion of Results - Technology Transfer

No technology transfer activities is taking place during this period.

First Quarter 1998, Objectives.

* Project termination.

FISCAL YEAR 1996

FISCAL YEAR 1996

INTRODUCTION.

Production continued to decline during 1996. After nearly four years of the project, it was observed that performance during the fourth year became adversely affected by several factors including water blockage, low residual oil saturation and wellbore mechanical problems.

The projects economics were greatly impacted by the cost of CO_2, consequently an evaluation of continuing to purchase CO_2 was made. Using the compositional reservoir model that was updated by EPTD using the newly developed geological model and the tertiary performance data from the last three years, The impact of continuous CO_2 purchases on ultimate recovery was determined. The following highlights the model results, which can also be reviewed in more detail following this introduction.

* The OOIP in the main fault block of the reservoir is 7 MMBO.

* The remaining recoverable oil reserves are in the range of 400 to 500 MBO.

* Incremental recovery due to additional CO_2 purchases is limited. The cost of purchasing new CO_2 is not economically justifiable.

The reservoir has about 2 BCF of CO_2 stored in the ground that can be used for continuous recycling to recover the remaining 400 MBO from the Marg Area 1 reservoir. Based on the reservoir model Texaco converted Kuhn #42 to a CO_2 injection well to improve the reservoir sweep efficiency and sweep a new area of the reservoir that had not been affected yet by CO_2 injection. Production throughout the year was primarily from Kuhn 15R with Kuhn 14 and Kuhn 38 being shut in most of the year. Kuhn 14 and 38 were put back on production after Kuhn 15R had mechanical problems. By year's end, all three wells were on production making a field average of 48 BOPD. No response was observed in the other producing wells since the change in the injection pattern, as a result of initiating CO_2 injection in well Kuhn #42. The following pages are the quarterly reports and attachments for the fiscal year 1996.

Post Waterflood CO_2 Miscible Flood in Light Oil
Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

First Quarter, 1996

Executive Summary

The Port Neches Marg Area 1 production stabilized at 215 BOPD for this quarter (Fig. 1). CO_2 purchase has been discontinued since November of 1995. Currently the project performance is being evaluated using a reservoir model in order to justify additional CO_2 purchases, especially with the production rate being below expectation. CO_2 purchases will be justified based on continuous operations. Water injection is continuing in the horizontal well to maintain reservoir pressure. Wells Kuhn #17 and Stark #10 (Fig. 2) continue to inject CO_2 in the vicinity of the producing wells Kuhn #15R and Kuhn #38. reservoir production and yield will be monitored for additional WAG cycles.

First Quarter 1996, Objectives

* Continue monitoring and optimizing the reservoir performance.

Production from wells Kuhn #15R and Kuhn #38 stabilized for this quarter at an average of 215 BOPD. Well Kuhn #42 is gas lifting an average of 200 BWPD, while all other producing wells are off production. We are awaiting the results of the reservoir simulator to make a decision on switching well Kuhn #42 to CO_2 injection to sweep the unaffected area located in the South-East portion of the reservoir. The injection well Stark #7 is plugged again after switching it to water injection for nearly one month. Water injection in the horizontal well is averaging 2000 BWPD at 950 PSI. The produced CO_2 stream of 3800 MCFD is compressed and re-injected in the reservoir. The average injection rate and pressure per well are 1900 MCFD and 1215 PSI. The reservoir pressure estimated using the tubing gradient of 0.26 PSI/ft and the above surface injection pressure is 2760 PSI. The compressor station availability has been over 95% of the time.

* Update the reservoir model.

The compositional reservoir model is being updated using the newly developed geological model to improve the reservoir description. Also included in the update is the tertiary performance data from the last 3 years. Texaco's Exploration and Production Technology Department (EPTD) is performing this task. The model work should be available during the next few weeks. One of the major objectives is to evaluate the effect of terminating CO_2 purchases on ultimate recovery. Other objectives are to evaluate the conversion of well Kuhn #42 to CO_2 injection and the individual well performance.

* Evaluate the need for additional CO_2 purchases.

The project performance during the last twelve months has been less than originally anticipated. The project continuous economics are greatly impacted by the cost of CO_2 purchases. Using the compositional reservoir model, Texaco is evaluating the impact of continuous CO_2 purchases (Fig. 3) on ultimate recovery. The reservoir model results will feed the economical model to perform a comparative analysis and determine the value added by purchasing additional CO_2. If the economics indicates unfavorable results, Texaco will recommend terminating CO_2 purchases while continuing to recycle the produced gas. The reservoir has about 2 BCF of CO_2 stored in the ground that can be used for continuous operations. Final decision will be made after a consulting with DOE and EPTD personnel.

Discussion of Results - Field Operations

The following is a list of the most recent well tests taken during the month of November of 1995, for the producing and injection wells:

Producers:	Kuhn #15R,	157 BOPD,	86 % BS&W,	840 PSI,	22 CK.
	Kuhn # 38,	74 BOPD,	90% BS&W,	1000 PSI,	19 CK.
Injectors:	Kuhn #17,	1425 MCFD,	1194 PSI.		
	Stark #10,	1978 MCFD,	1190 PSI.		
	Marg Area 1H,	1986 BWPD,	950 PSI.		

Allocated production, structure map and CO_2 delivery are included in Figure 1 through 3.

Discussion of Results - Technology Transfer

Texaco will be presenting a paper at the up coming SPE/DOE Tenth Symposium on IOR to be held in Tulsa in April of 1996. The paper is entitled : " A new analytical method to evaluate, predict and improve CO_2 flood performance in sandstone reservoirs".

A paper entitled " Ranking of Texas reservoirs for Application of Carbon Dioxide Miscible Displacement" written by SAIC is included following this report.

Second Quarter 1996, Objectives

* Continue to monitor and optimize reservoir performance
* Make a decision on continuing CO_2 purchases
* Complete the reservoir model.

Port Neches CO2 Project
Allocated Production

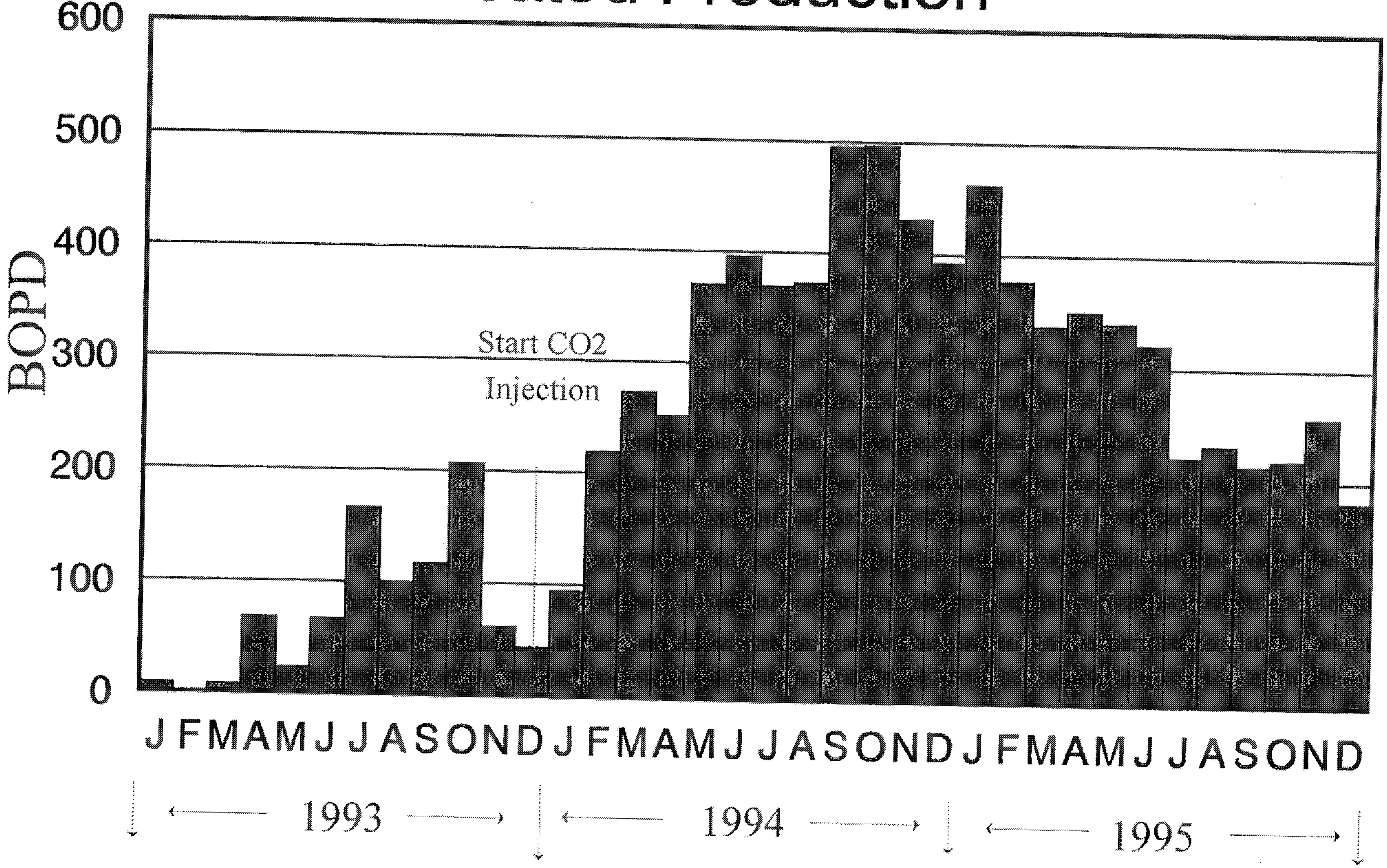


Fig. 1

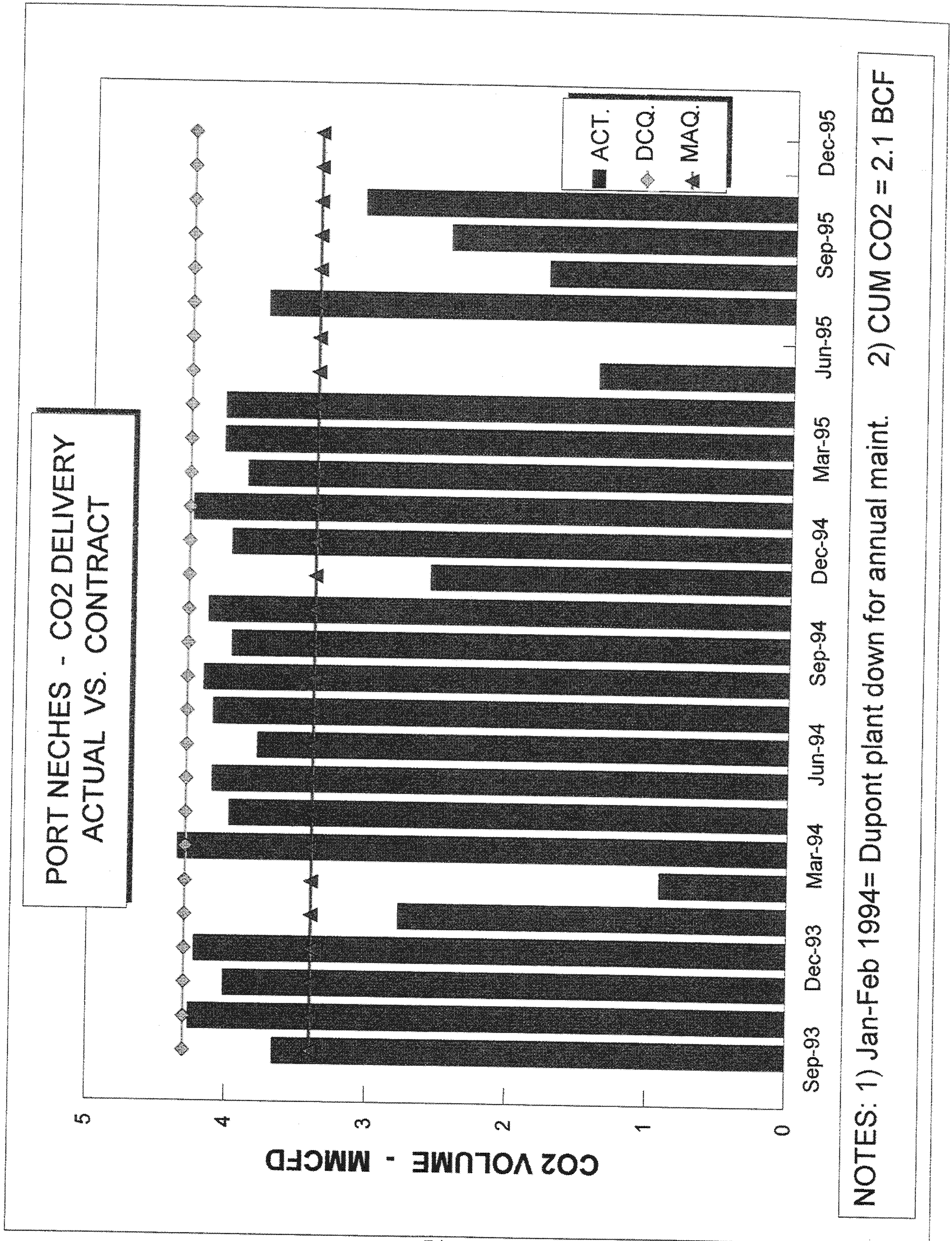
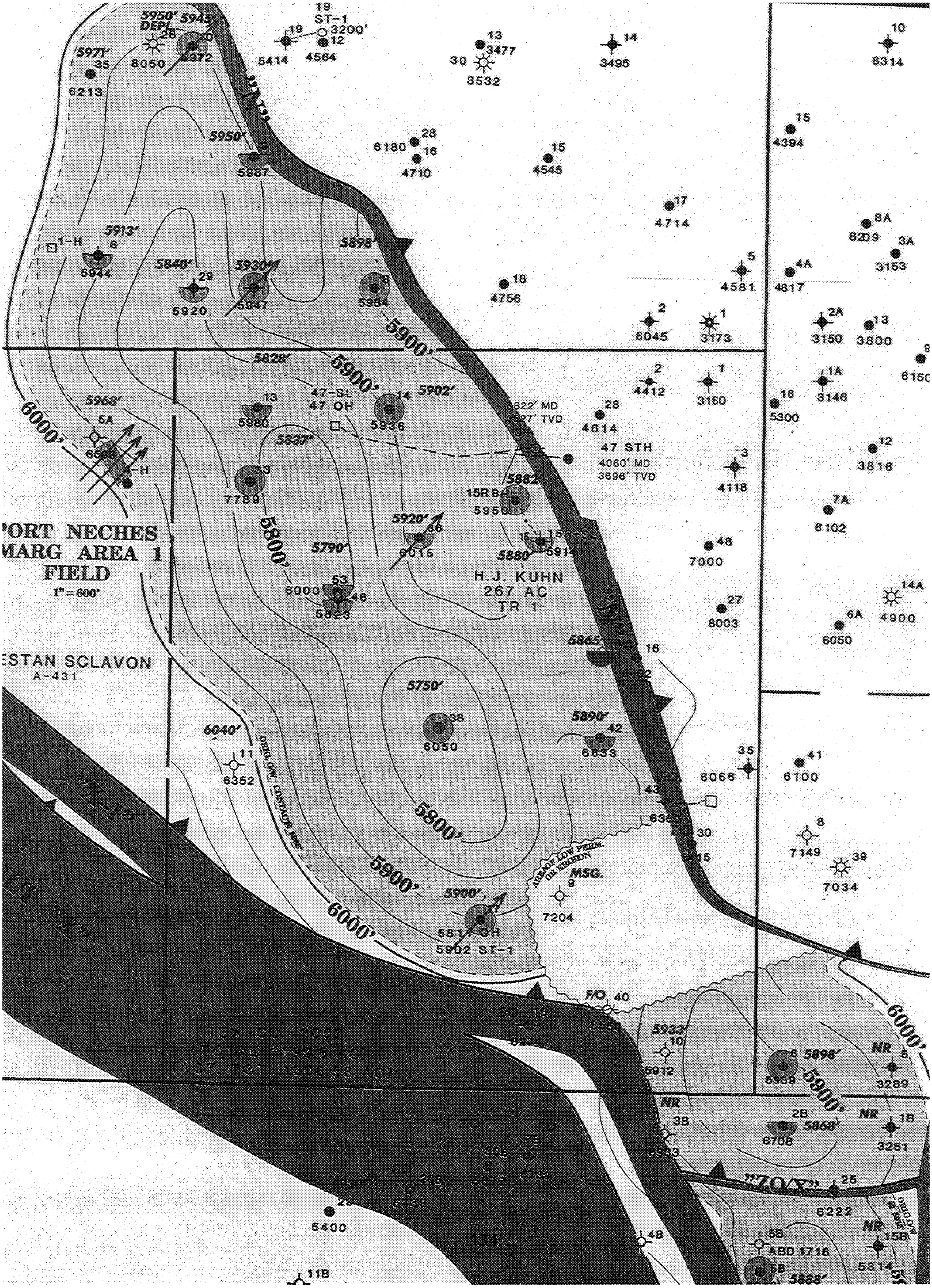

PORT NECHES - CO2 DELIVERY
ACTUAL VS. CONTRACT
CO2 VOLUME - MMCFD
0
1
2
3
4
5
Sep-93
Dec-93
Mar-94
Jun-94
Sep-94
Dec-94
Mar-95
Jun-95
Sep-95
Dec-95
ACT.
DCQ.
MAQ.
NOTES: 1) Jan-Feb 1994= Dupont plant down for annual maint. 2) CUM CO2 = 2.1 BCF

Fig. 3


PORT NECHES
MARG AREA 1
FIELD
1" = 800'
ESTAN SCLAVON
A-431
H.J. KUHN
267 AC
TR 1
47-SL
47 OH
47 STH
4060' MD
3696' TVD
15R BH
AREA OF LOW PERM. OR EROSION
MSG.
ORIG. O/W CONTACT
F/O
ABD 1716
"ZO/X"
"X-1"
5950' DEPL
5945'
5971'
5950'
5913'
5840'
5930'
5898'
5900'
5828'
5902'
5968'
6000'
5837'
5882'
5800'
5920'
5790'
5880'
5865'
5750'
5890'
6040'
5933'
5898'
5868'
5888'
NR

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Oct. 1, 1995 - Dec. 31, 1995**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTIN ELEMENT	9. DURATION 1993				1994				1995				CURRENT FISCAL YEAR 1996				FY 1997						10. PERCENT COMPLETE	
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q			a. Plan	b. Actual
1.1	Geologic & Engineering				1																			100%	100%
1.2	Extraction Technology				2																			100%	100%
2.1	Recording Daily Production				3																A			50%	50%
2.2	Reservoir Charac-terization				4	B					C													100%	100%
2.3	Site Operation & Field Work		D	E					F															100%	100%
2.4	CO2			6																				50%	50%
2.5	EH&S Monitoring & Compliance		G H	7																			I	50%	50%
3.1	CO2 Screening Model						J	8																100%	100%
3.2	Environmental Analysis									9														100%	100%
3.3	FDD Database & Model									K				10										80%	80%
3.4	Technical Publications								L								L		11				11	50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

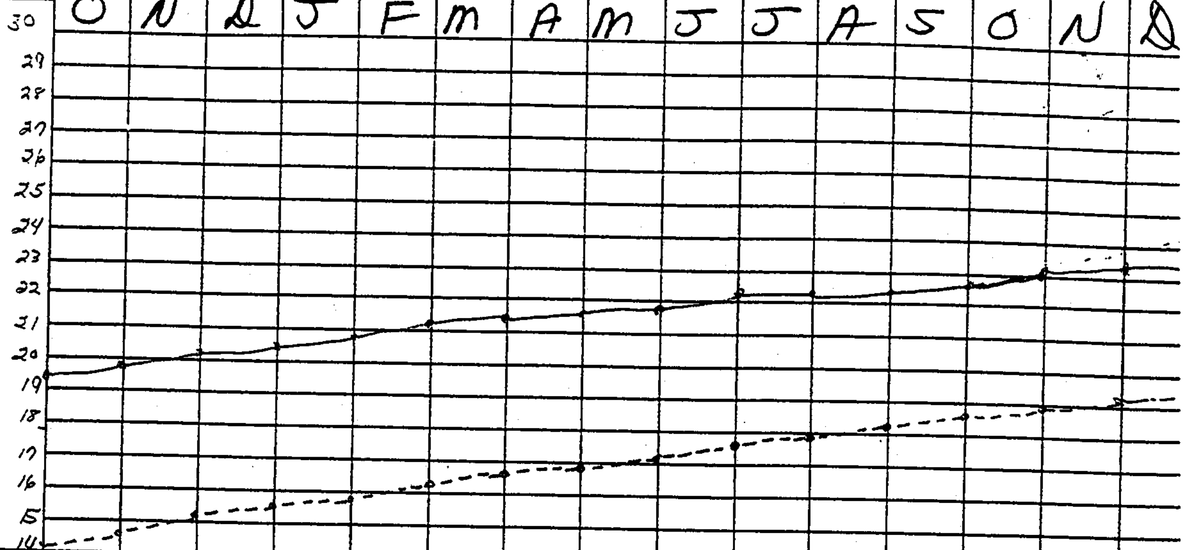
1. IDENTIFICATION NUMBER	2. PROGRAM/PROJECT TITLE	3. REPORTING PERIOD
DE-FC22-93BC14960	CLASS I	10-01-95 THRU 12-31-95

4. PARTICIPANT NAME AND ADDRESS	5. START DATE / 6. COMPLETION DATE
TEXACO EXPLORATION & PRODUCTION INC. 400 POYDRAS ST. NEW ORLEANS, LA. 70130	5. START DATE: 6-1-93 6. COMPLETION DATE 12-31-97

7. FY | 8. MONTHS: O N D J F M A M J J A S O N D

9. COST STATUS

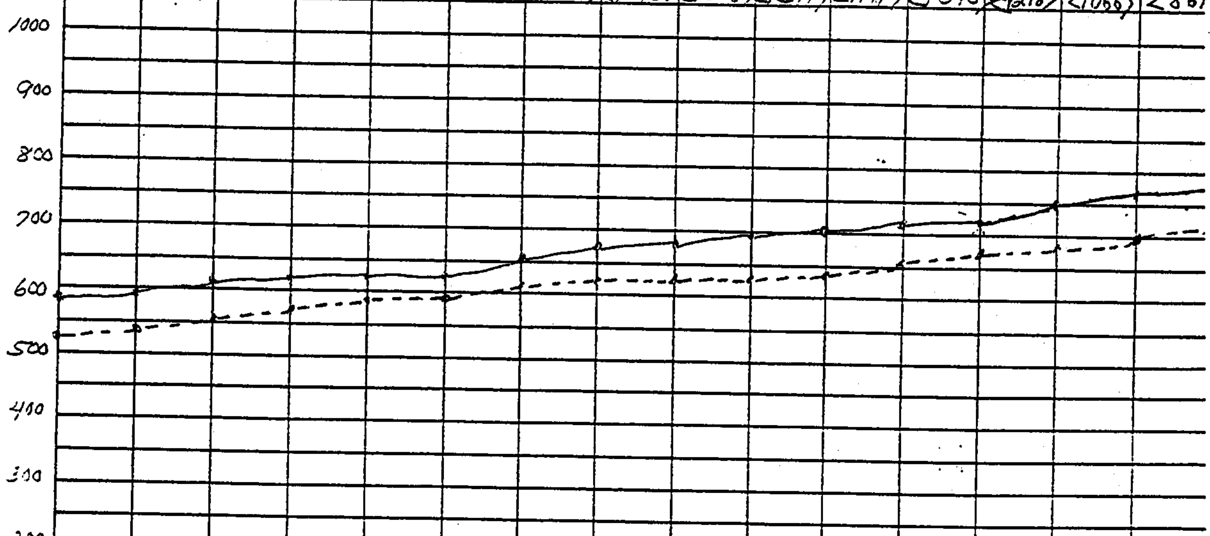
- a. $ Expressed in: MILLIONS
- b. Budget and Reporting No. AC1510100
- c. Cost Plan Date 6-23-93
- d. Actual Costs Prior Years 19,722
- e. Planned Costs Prior Years 14,082
- f. Total Estimated Cost for Contract 10,885
- g. Total Contract Value 2.985
- h. Estimated Subsequent Reporting Period



Accrued Costs	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	630	630	214	330	330	330	330	330	330	330	330	330	330	330	330
h. Actual	214	239	319	490	300	252	91	255	321	135	80	229	508	178	131
i. Variance	416	391	<105>	<160>	30	77	239	75	09	195	250	101	<178>	152	199
j. Cumulative Variance	<2142>	<1751>	<1856>	<2016>	<1986>	<1909>	<1670>	<1595>	<1586>	<1591>	<1141>	<1040>	<1218>	<1066>	<867>

10. LABOR STATUS

- a. Labor Expressed in: THOUSANDS
- b. Labor Plan Date: N/A DIRECT LABOR
- c. Planned Labor Prior Fiscal Years # 530
- d. Actual Labor Prior Fiscal Years 582
- e. Total Estimated Labor for Contract # 465
- f. Total Contract Labor N/A



LEGEND
Planned: ------
Actual: ______
Projected: ....

Labor	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	15	15	15	13	13	13	13	13	13	13	13	13	13	13	13
h. Actual	15	11	9	5	15	18	19	8	17	3	4	5	5	18	4
i. Variance	2	4	6	8	<2>	<5>	<6>	5	<4>	10	9	8	8	<5>	9
j. Cumulative Variance	<43>	<39>	<33>	<25>	<27>	<32>	<38>	<33>	<37>	<27>	<18>	<10>	<2>	<7>	<2>

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY

MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE

(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD Oct 1, 1995 - Dec. 31, 1995	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	PROJECT 80% COMPLETE
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	LSU WORK WILL BE COMPLETED IN SPRING, 1996
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted **U. S. Department of Energy**	2. Federal Grant or Other Identifying Number Assigned By Federal Agency **DE-FC22-93BC14960**	OMB Approval No. 0348-0039	Page 1	of 1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number 51-0265713	5. Recipient Account Number or Identifying Number 323037151	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual
8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) January 1, 1995	To: (Month, Day, Year) December 31, 1997	9. Period Covered by this Report From: (Month, Day, Year) 10-01-95	To: (Month, Day, Year) 12-31-95

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$2,606,756.28	$851,411.27	$3,458,167.55
b. Recipient share of outlays (64.39%)	$1,678,490.37	$548,223.72	$2,226,714.09
c. Federal share of outlays (35.61%)	$928,265.91	$303,187.55	$1,231,453.46
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$928,265.91	$303,187.55	$1,231,453.46
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$2,056,333.09	($303,187.55)	$1,753,145.54

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 89.34%	c. Base $27,134.72	d. Total Amount $24,242.16	e. Federal Share $8,632.63

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

NOTE: This report reflects a one time change to report total cash outlay including advances instead of actual charges.

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title **Sami Bou-Mikael - Project Manager**	Telephone (Area code, number and extension) (504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted Jan. 19, 1996

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

file: DOERPT12.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

4. Federal grant or other identification number **DE-FC22-93BC14960**

5. Recipient's account number or identifying number **323037151**

6. Letter of credit number **NA**

7. Last payment voucher number **-**

Give total number for this period

8. Payment Vouchers credited to your account **-**

9. Treasury checks received (whether or not deposited) **0**

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year) **10/01/95** TO (month,day,year) **12/31/95**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$222,321.30
	d. Total receipts (Sum of lines b and c)	$222,321.30
	e. Total cash available (Sum of lines a and d)	$222,321.30
	f. Gross disbursements	$222,321.30
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$222,321.30
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED 01/29/96
	TYPED OR PRINTED NAME AND TITLE Sami Bou-Mikael - Project Manager	TELEPHONE (Area Code, Number, Extension) (504) 593-4565

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Second Quarter, 1996

Executive Summary

Texaco terminated the CO_2 purchase agreement with Cardox due to the declining production from the project during 1995. This decision was supported by the DOE and the Exploration and Production Technology Department (EPTD) who developed the model to simulate reservoir performance. Texaco is planning to continue recycling produced CO_2 to recover the remaining 400 MBO from the Marg Area 1 reservoir. Currently one well is remaining on production Kuhn #15R after the second producing well Kuhn #38 sanded up. Changing the water and CO_2 injection patterns should improve the sweep efficiency and restore production from other existing wells.

Second Quarter 1996, Objectives

* Make a decision on continuing CO_2 purchases

Texaco terminated the CO_2 purchase agreement with Cardox due to the decline in production during 1995, and after exploring various alternatives to restore production from the project. Purchases of new CO_2 was not necessary since it did not contribute to the recovery of new reserves from the project, and the stored CO_2 in the reservoir was sufficient to recover the remaining reserves through recycling. The Current purchased CO_2 utilization factor is higher than the originally estimated (2.8 MCF/ BO vs. 2.5 MCF/BO). This evaluation was based on performance predictions by a compositional reservoir model built by EPTD, and the overall project economics. The decision was communicated timely to the DOE to obtain their support.

<u>* Complete the reservoir model.</u>

EPTD built a compositional model to evaluate the project performance and improve the decision making process for project operations. The model included history matching of primary and secondary production and early CO_2 flooding, in addition to various production runs. The reservoir model (COMP III by SSI) integrated the results of the Geologic model to improve the reservoir description. The SP curves from the well logs were used to determine the shale content and derive the shale-corrected porosity. The porosity was utilized to calculate the permeability based on porosity/permeability transform. A four-layer model that betters represented the heterogeneity of the reservoir, and provided a flow path for the CO_2 to breakthrough into the upper portion of the reservoir. It also provided a more accurate view of the areal extent of the reservoir by eliminating the area to the south of the reservoir where Kuhn #6 is located, and reduced the total area of the reservoir by about 31% due to a localized shale-out.

EPTD modified the fault connections in the geologic model to isolate the main fault block, and utilized the model to perform a history match and make prediction runs. The emphasis was placed on obtaining a total fluid match as opposed to individual well match. The individual well performance was improved by producing the wells out to a point in time where the oil rates matched with the current values. This allowed the model to forecast production rates that are aligned with the current production rates. Prediction runs were made to evaluate the need for changing the injection pattern and to quantify the incremental oil that could be obtained with additional CO_2 purchases.

The results indicated that the new geologic description of the reservoir allows for an improved performance prediction and a reasonable estimate of oil recovery based upon two years performance history of the CO_2 flood. However it requires additional modification to fully match well performance. The following highlights the model results which can also be reviewed in more detail in the attached appendix:

* The OOIP in the main fault block of the reservoir is 7 MMBO.

* The remaining recoverable oil reserves are in the range of 400 to 500 MBO.

* Incremental recovery due to additional CO_2 purchases is limited. The cost of purchasing new CO_2 is not economically justifiable.

* Continue monitoring and optimizing the reservoir performance.

Based on the reservoir model Texaco converted Kuhn #42 to a CO_2 injection well to improve the reservoir sweep efficiency and sweep a new area of the reservoir that has not been affected yet by CO_2 injection. Currently the well is injecting CO_2 at a rate of 1823 MCFD. Wells Kuhn #17 and Marg Area #1H are injecting water to maintain reservoir pressure and counter balance the reservoir total fluid withdrawal. Stark #10 well is continuing to inject CO_2 in the northern section of the reservoir. Production from well Kuhn #15R remains stable at an average rate of 125 BOPD, and it is anticipated to improve as the CO_2 injected in well Kuhn #42 reaches the well later this year. The second producing well Kuhn #38 sanded up after producing from an openhole Gravel pack system for about 1 year. The pressure in the reservoir is stable based on the surface CO_2 injection pressure, however, the injection rate in slightly higher than the withdrawal rate which should help increase the reservoir pressure and therefore improve the production rate.

Discussion of Results - Field Operations

The following is a list of the most recent well tests taken during the month of March of 1996, for the producing and injection wells:

Producers:	Kuhn #15R,	137 BOPD,	82 % BS&W,	840 PSI,	22 CK.
	Kuhn # 38,	24 BOPD,	90% BS&W,	1100 PSI,	19 CK.

Injectors:	Kuhn #42,	1823 MCFD,	1181 PSI,
	Stark #10,	1040 MCFD,	1182 PSI.
	Kuhn #17,	967 BWPD,	1780 PSI.
	Marg Area 1H,	823 BWPD,	1780 PSI.

Discussion of Results - Technology Transfer

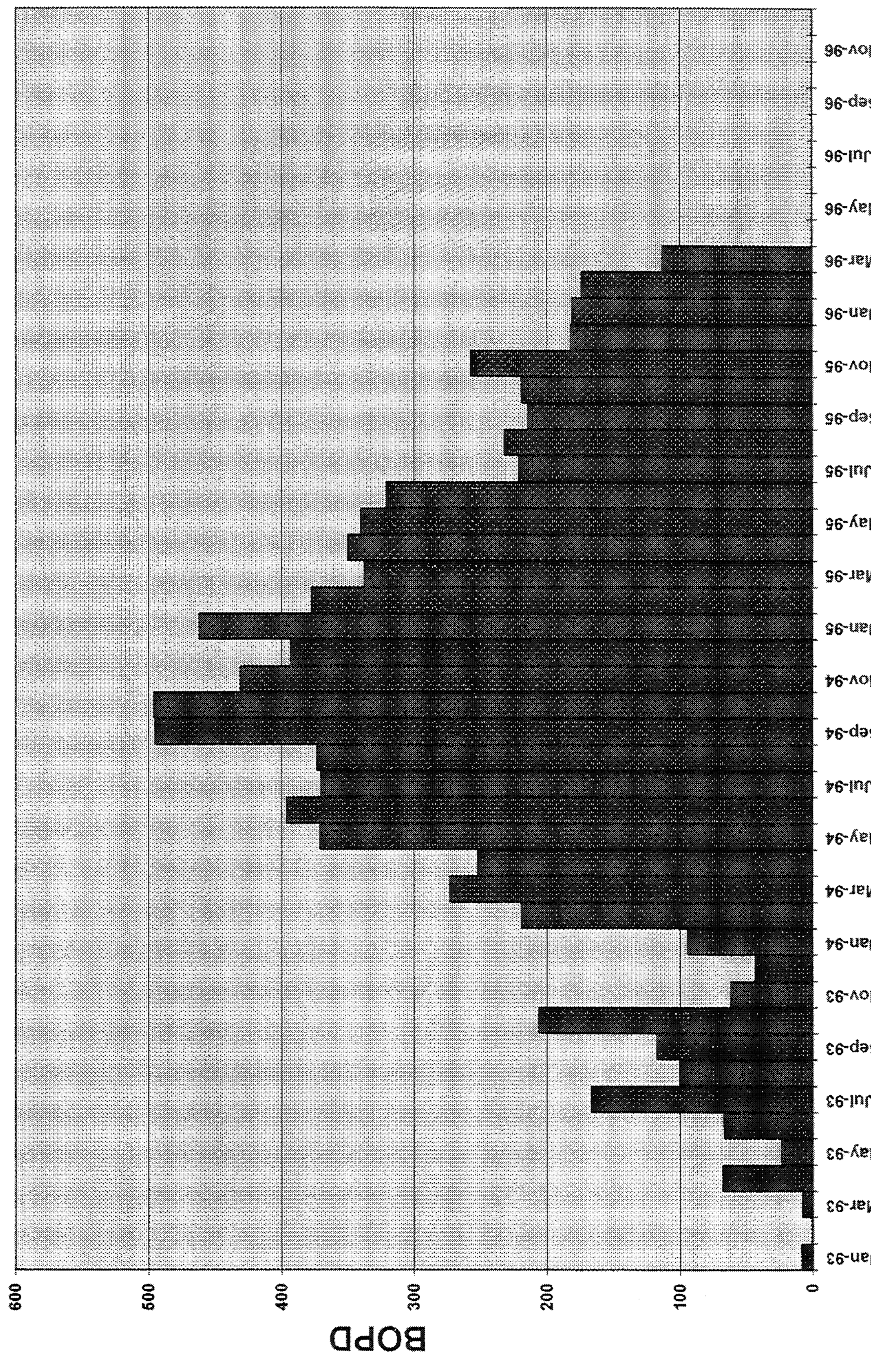
As a part of its commitment to transferring the technology to the industry, Texaco presented a paper at the April 1996 SPE/ DOE Symposium on IOR in Tulsa, Oklahoma. The paper addressed the progress of the CO_2 flood at Port Neches and a new analytical method to select, design and predict the performance of new CO_2 floods in sandstone reservoirs.

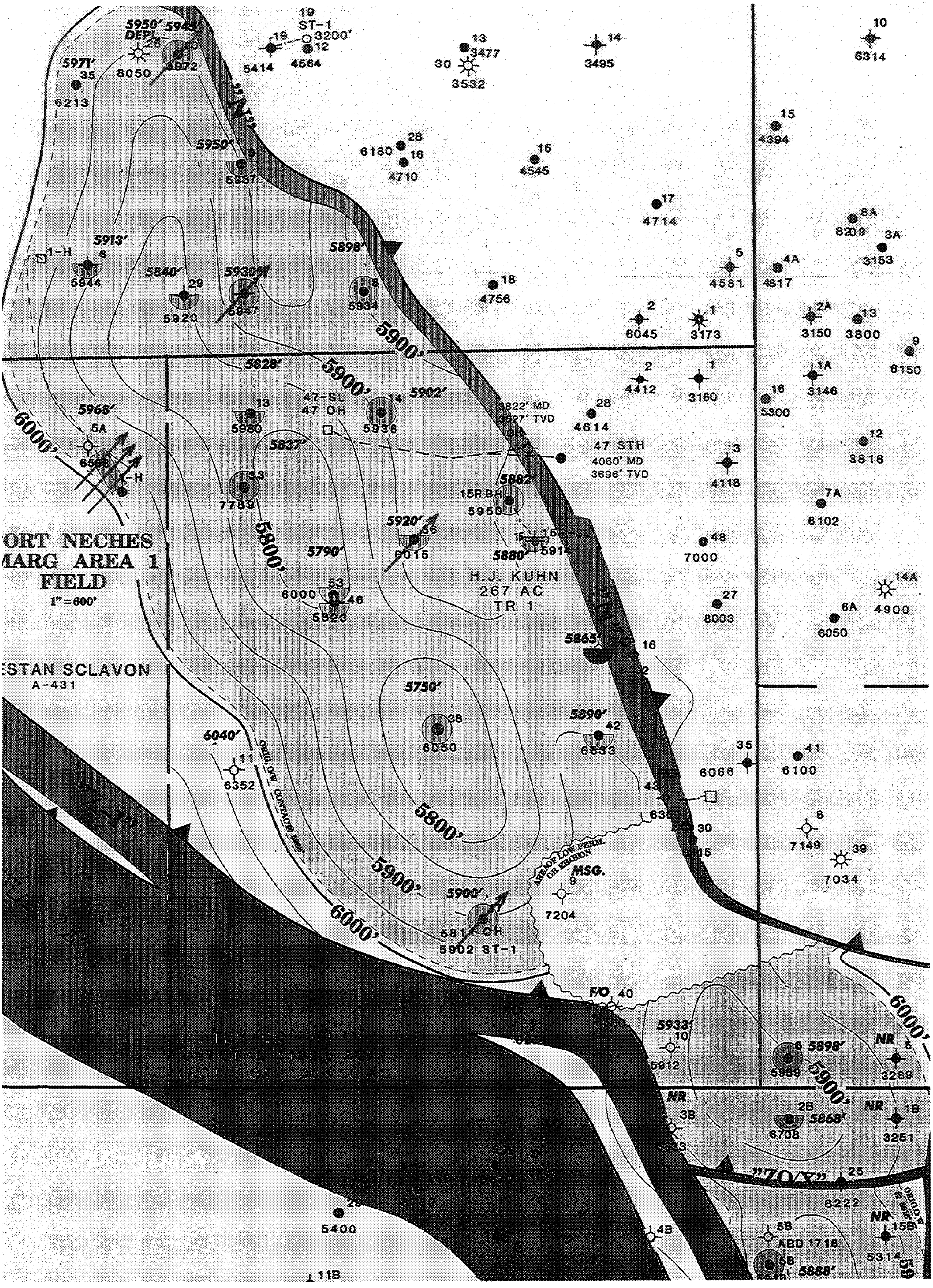
Second Quarter 1996, Objectives

* Continue to monitor and optimize reservoir performance.

* Evaluate the effectiveness of the reservoir model.

PORT NECHES CO2 PROJECT
ALLOCATED PRODUCTION





ORT NECHES
MARG AREA 1
FIELD
1"=600'
ESTAN SCLAVON
A-431
H.J. KUHN
267 AC
TR 1
47 STH
4060' MD
3696' TVD
3822' MD
3627' TVD
47-SL
47 OH
15R BHL
5950' DEPL.
5900'
5800'
6000'
"N"
"K-1"
"70/X"
AREA OF LOW PERM. OR EROSION
MSG.
F/O
NR
ABD 1718
5902 ST-1
ORIG. O/W CONTACT @ 6005'

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY

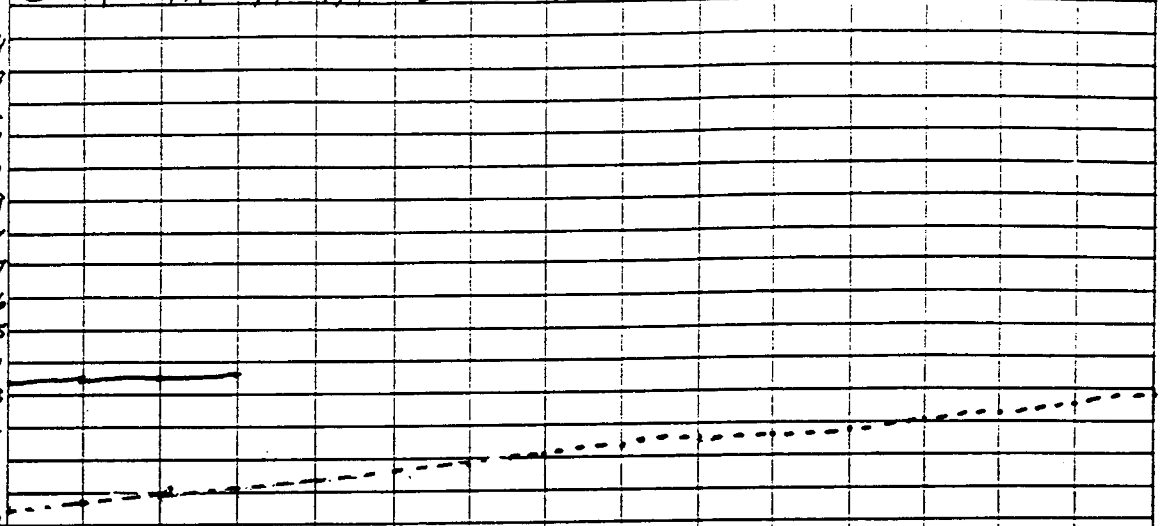
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER DE-FC22-93BC14960	2. PROGRAM/PROJECT TITLE CLASS I	3. REPORTING PERIOD 1-1-96 thru 3-31-96
4. PARTICIPANT NAME AND ADDRESS TEXACO Exploration & Production Inc. 400 Poydras St. New Orleans, LA. 70130	5. START DATE: 6-1-93 6. COMPLETION DATE 12-31-97	

7. FY
8. MONTHS: J F M A M J J A S O N D J F M

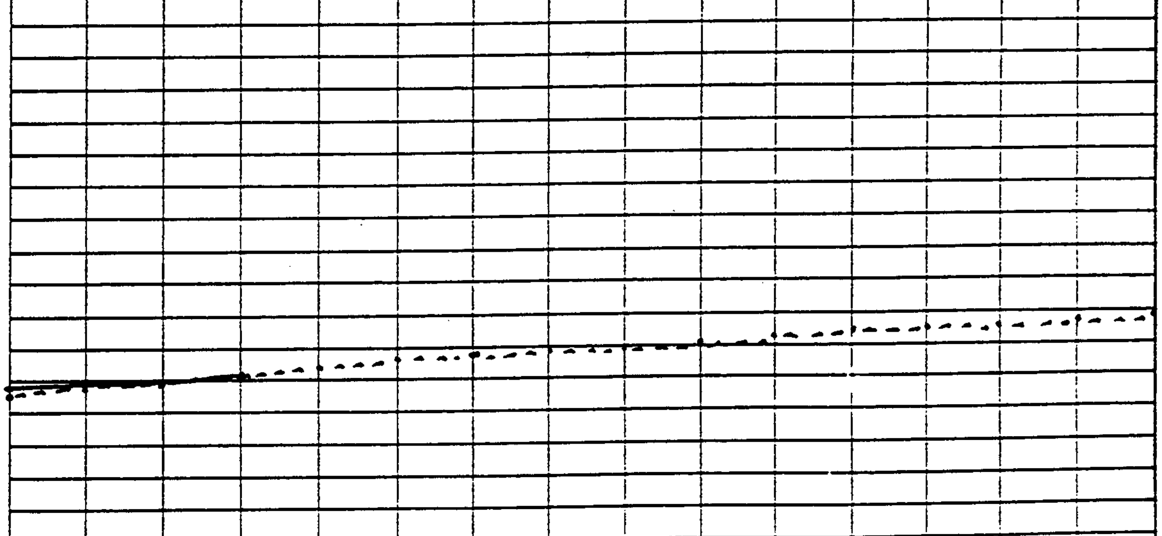
9. COST STATUS
a. $ Expressed in: THOUSANDS
b. Budget and Reporting No. AC1510100
c. Cost Plan Date 6-23-93
d. Actual Costs Prior Years $23,417
e. Planned Costs Prior Years 19,516
f. Total Estimated Cost for Contract 10,085
g. Total Contract Value 2,985
h. Estimated Subsequent Reporting Period



Accrued Costs	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
h. Actual	46	51	65												
i. Variance															
j. Cumulative Variance															

10. LABOR STATUS
a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A Direct Lbr
c. Planned Labor Prior Fiscal Years $731
d. Actual Labor Prior Fiscal Years $738
e. Total Estimated Labor for Contract $465
f. Total Contract Labor N/A

LEGEND
Planned: - - - - - -
Actual: ———————
Projected: . . . .



Labor	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
h. Actual	0	9	4												
i. Variance															
j. Cumulative Variance															

11. MILESTONES — STATUS — COMMENTS

a. b. c. d. e. f. g.

Previous adjustment of <$46,778.88> to year ending Dec. 1995 has been made here. This info based on changing factors for 1995 actuals.

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
FEDERAL ASSISTANCE MILESTONE PLAN
OMB Burden Disclosure Statement

DOE F4600.3
(01-93)

FORM APPROVED
OMB NO. 1910-0400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Field test for cost effectiveness of water disposal in low pressured gas reservoirs	**Oct. 01, 1995 thru Dec. 31, 1995**	**DE-FG21-95MT32061**

4. PARTICIPANT NAME AND ADDRESS	5. START DATE / 6. COMPLETION DATE
MVP PRODUCTION INC. **400 Poydras St.** **New Orleans, LA 70130**	5. START DATE **Sept. 30, 1995** 6. COMPLETION DATE **Sept. 29, 1999**

Program/Project Duration

Identification Number	Planning Category (Work Breakdown Structure Tasks)	1993 OCT	1993 DEC	1994 FEB	1994 APR	1994 JUN	1994 AUG	1994 OCT	1994 DEC	1995 FEB	1995 APR	1995 JUN	1995 AUG	1995 OCT	1995 DEC	1996 FEB	1996 APR	1996 JUN	1996 AUG	1996 OCT	1996 DEC	1997 FEB	1997 APR	1997 JUN	1997 AUG	
1.0	UIC Permit	A		B																						
2.0	Unitization	B		B																						
3.0	Workover Injection Well		A		B																					
4.0	Workover Producing Well		A		B																					
5.0	Injection/Flowline Installations				B																					
6.0	Water Injection				A																					
7.0	Gas Production							A																		
8.0	Reservoir simulation				A				B																	
9.0	SPE Paper											A						B								
10.0	Final Report																									A
11.0	Recording Monthly Production																									
12.0	Recording Monthly Injection																									

REMARKS

SIGNATURE OF RECIPIENT AND DATE

SIGNATURE OF U.S. DEPARTMENT OF ENERGY (DOE) REVIEWING REPRESENTATIVE AND DATE

05/08/96

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Jan 1, 1996 - Mar 31, 1996**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

123/1332A96.WK4

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No.	Page	of
U. S. Department of Energy	DE-FC22-93BC14960	0348-0039	1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	323037151	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
January 1, 1995	December 31, 1997	01-01-96	03-31-96

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$2,919,187.14	$11,753.76	$2,930,940.90
b. Recipient share of outlays (64.39%)	$1,879,664.60	$7,568.25	$1,887,232.85
c. Federal share of outlays (35.61%)	$1,039,522.54	$4,185.51	$1,043,708.05
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$1,039,522.54	$4,185.51	$1,043,708.05
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,945,076.46	($4,185.51)	$1,940,890.95

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box)			
	[X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 107.37%	c. Base $12,660.15	d. Total Amount $13,593.20	e. Federal Share $4,840.54

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Sami Bou-Mikael - Project Manager	(504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted
	Apr. 25, 1996

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

4. Federal grant or other identification number	DE-FC22-93BC14960
5. Recipient's account number or identifying number	323037151
6. Letter of credit number	NA
7. Last payment voucher number	-

Give total number for this period

8. Payment Vouchers credited to your account	-
9. Treasury checks received (whether or not deposited)	0

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year)	TO (month,day,year)
01/01/96	03/31/96

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$303,187.62
	d. Total receipts (Sum of lines b and c)	$303,187.62
	e. Total cash available (Sum of lines a and d)	$303,187.62
	f. Gross disbursements	$303,187.62
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$303,187.62
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED 05/08/96
	TYPED OR PRINTED NAME AND TITLE Sami Bou-Mikael - Project Manager	TELEPHONE (Area Code, Number, Extension) (504) 593-4565

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

Appendices

TEXACO

E&P TECHNOLOGY DEPARTMENT

Reservoir Simulation Model for Port Neches CO_2 Project Orange County, Texas

By:

C. K. Chea

D. W. Davis

E. J. Hrkel

REPORT 96-0048

PROJECT 14-1973-030 **CONFIDENTIAL** **MARCH 1996**

EXECUTIVE SUMMARY

The Port Neches CO_2 project began CO_2 injection into the Marginulina 1 reservoir in 1993. To date, approximately 219 MBO, or 3.1% of the original oil-in-place in the Main fault block area, has been produced since the start of CO_2 injection. A new geological model has been incorporated into a reservoir simulation model to predict what the future performance of the reservoir will be under various operating scenarios. Use of the model provides reserve recovery estimates for continued operations, purchase of additional CO_2, and changes made to the injection pattern used in the field.

The new geologic and reservoir simulation model indicates, as did the original model, that communication exists between the Main fault block and the Kuhn #6 fault block. CO_2 injection into Kuhn #6 was performed in the field, however, and showed that these two fault blocks are isolated. Based upon this information, only 70% of the original Marg. 1 CO_2 project area will be affected by CO_2 injection. The reservoir model indicates that approximately 10% OOIP will be recovered by CO_2 injection. Based upon this estimate, 500 MBO of recoverable reserves remain in this project area.

There is shown to be an increase in recovery of 100-150 MBO by purchasing CO_2 for an additional year. This improved recovery will not support the additional expenditure, and is therefore not recommended.

The conversion of an existing production well to a CO_2 injection well is recommended even though the model does not fully support the work. This work can be done at low cost and may improve the areal sweep efficiency of the project. Limitations of the model such as current oil saturation distribution within the reservoir, and unidentified geological complexities such as the silt-filled channel, suggests that low cost projects such as this type can be attempted, even though contradictory to the model.

INTRODUCTION

The Port Neches Marginulina reservoir was discovered during 1934 by Texaco with the drilling of the J. V. Polk "B" #2 well. This reservoir was rapidly developed and extended into the H. J. Kuhn and W. H. Stark "B" leases. By 1965 the reservoir pressure in the Main fault block had dropped to 100 psi and all wells produced were on sucker rod beam pumps. A waterflood began at this time by injecting water into the H. J. Kuhn #17 and W. H. Stark "B"#10, and later the H. J. Kuhn #42 was added as an injector. Primary recovery was 4.2 MMBO or 42% OOIP and secondary (waterflood) recovery was 1.5 MMBO or 15% OOIP. By 1992 the production from the reservoir had declined to 80 BOPD and a CO_2 injection project was recommended. Given the high cost of the project, Texaco applied for funding from the U. S. Department of Energy (DOE) in their Class I Oil Program for fluvial-dominated deltaic reservoirs, and were awarded $8.7 million, or 35.5% of the project cost, during 1993. In return for this funding by DOE, Texaco would demonstrate the application of the CO_2 recovery process and transfer the technology to the industry. CO_2 injection into Marginulina reservoir began in 1993.

A reservoir model was constructed during 1992 using SSI COMP III to evaluate the development options available. This model divided the 30'-40' sandstone reservoir into two layers and assigned permeabilities of 420 md to the top layer and 1080 md to the bottom layer based upon a Dykstra Parson's coefficient of 0.5 and an average permeability of 1000 md. By utilizing this model and the DOE/EPTD PC program CO_2PM, a recovery factor of 19% of the OOIP was obtained and used in the production forecast. The Main fault block and the H. J. Kuhn #6 fault block would be swept by injection into the Main fault block only, as previous pressure data indicated that the two fault blocks were in communication. A horizontal CO_2 injection well was also drilled in the Main fault block to improve the areal sweep efficiency of the injection process. The project would also expand into the J. V. Polk "B"#5 fault block during 1995 by the drilling of a CO_2 injection well. Peak production was estimated at 800 BOPD by 1995.

After implementing this project, it became apparent that production levels were less than anticipated and a 3-D seismic survey shot over the field indicated that the Polk "B"#5 fault block was too small to effectively utilize the CO_2 recovery process. CO_2 injection into the H. J. Kuhn #6 during 1995 also indicated that the Main fault block was separate from the Kuhn #6 fault block. To effectively sweep this fault block an additional well would have to be drilled. Given these complications, a new geologic model was constructed to investigate if the historical production levels under CO_2 injection were realistic and what the future operating strategy for the reservoir should be.

The new geologic model was constructed by utilizing the 3-D survey information and the knowledge, as determined in the field, that the Main fault block and the Kuhn #6 fault block were separated. The geologic model utilized the SP curve from existing wells to determine shale volumes present in each well, and derived a shale corrected porosity. This porosity was utilized to calculate permeability based upon a developed porosity/permeability transform. This data along with structural tops were incorporated into the geologic modeling package StrataModel, and a four layer geologic model was developed. This model better represented the heterogeneity of the reservoir and the four layers provided flow paths for the CO_2 to breakthrough into the upper portions of the reservoir, as was seen in the field. This model was then imported into Scientific Software Intercomp (SSI) COMPIII simulation package. **Figures 1 through 4** are structure maps of these four layers.

HISTORY MATCH

This new geologic model indicates that the Main fault block area and the Kuhn #6 fault block are isolated by a silt-filled channel as shown in **Figure 1**. The separation of these two areas has limited the areal sweep efficiency of the CO_2 project and limits our ability to improve oil recovery in the future. The Main fault block area contained 7.0 MMBO upon discovery in 1934 while the Kuhn #6 fault block contained 3.0 MMBO. Communication between these two fault blocks was assumed in the original design of the project based upon the pressure history of the individual blocks, and an incremental oil recovery of 19% OOIP (or 1.9 MMBO) was estimated.

EPTD modified the fault connections in the geologic model to properly seal the two fault blocks of the Main fault block, and utilized this model to perform a history match and make prediction runs to see if the performance of the reservoir could be matched. During the history match phase of the project, emphasis was placed upon obtaining a <u>total fluid match</u> for each of the fault blocks as opposed to an individual well match, due to the limited time available to complete the project. The intent of the project was to see if the primary and secondary (waterflood) history of the reservoir could be reasonably matched, and if an improved production forecast could be obtained. A reasonable history match of oil, water, and gas production was obtained for the Main fault block and Kuhn #6 fault blocks shown in **Figures 6 through 8**. The individual well performance was improved by producing the wells out to a point in time where the oil rates matched with current values. This allowed the model to forecast production rates that are aligned with current production rates. Prediction runs were made to evaluate injection well conversions and production profiles for new wells, and quantified the incremental oil that could be obtained with an additional 1 year of CO_2 purchases.

Results indicated that the new geologic description of the reservoir allows for an improved performance prediction and reasonable estimates of oil recovery based upon two years performance history of the CO_2 flood, but requires further modifications to fully match well performance. Premature water breakthrough in wells Kuhn #16 and #38 indicates that the geology and/or oil-water contact in the vicinity of these wells should be investigated. Communication between the Main fault block and the Kuhn #6 fault block also indicates that the geology must be changed to match results of Kuhn #6 CO_2 huff-puff test, which showed no communication between the blocks. Even given these limitations, the new geologic description of the reservoir provides an improved performance prediction for the performance of the CO_2 flood.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1) Original oil-in-place for the reservoir model is approximately 10 MMBO. Of this amount, 3 MMBO or 30% is contained within the isolated Kuhn #6 fault block.

2) Remaining oil reserves are approximately 400-500 MBO if the project is limited to the Main fault area.

3) An additional one year of CO_2 purchases may improve oil recovery by as much as 100-150 MBO. This incremental oil recovery will not support an additional year of CO_2 purchases.

4) Conversion of Kuhn #42 to a CO_2 injection well may improve the areal sweep efficiency of the CO_2 flood in the Main fault block area.

Recommendations

1) The purchase of any additional CO_2 for the Main fault block area is not recommended.

2) Convert Kuhn #42 to a CO_2 injection well.

3) Reestablish production from Stark "B" #8 after running a static bottomhole pressure survey.

4) Determine if it is economically feasible to run gas lift valves in Kuhn #6.

PREDICTION RUNS

Prediction runs were made using a reservoir simulation model which introduced a new geological interpretation of the Marginulina reservoir. A low permeability section separating the Main fault block area and the Kuhn #6 fault block was included to represent the silt-filled channel thought to be separating the two blocks. The new model also divides the reservoir into four layers, thus providing greater vertical heterogeneity and gravity effects than the original two layer model. Prediction runs focused upon the following issues:

- The effect of discontinuing CO_2 purchases on oil recovery.
- Improvements in areal sweep efficiency resulting from conversion of the Kuhn #42 well to a CO_2 injection well.
- Oil recovery potential from Kuhn #6 fault block.

To improve the prediction phase of this study, production from the Kuhn #6, #15-R, #33, #38 and Stark "B" #8 wells was continued until each well reached an oil rate equal to their actual current rate. This resulted in an additional 394 MBO produced from the reservoir prior to making prediction runs. This additional production was distributed as follows:

Well	Additional Oil Produced	Recent Test Used In Model
Kuhn # 6	4,000 BO	50 BOPD
Kuhn #15-R	13,000 BO	180 BOPD
Kuhn #33	212,000 BO	50 BOPD
Kuhn #38	4,000 BO	80 BOPD
Stark "B" #8	161,000 BO	50 BOPD

As can be seen from these numbers, the Kuhn #33 and Stark "B" #8 locations required the most adjustment to the oil saturation in order to match well performance. The most recent well test of 100% water on Kuhn #33 suggests that further refinements to the model can be made, but much of the optimism of the predictions has been removed. Prediction runs were made which focused upon production from Kuhn #15-R, #38 and Stark "B" #8.

Case Summary

A summary of the final prediction runs is described below. Wells Kuhn #15-R and #38 were given a maximum total fluid rate of 700 RB/D while Stark "B" #8 was set at 500 RB/D. A description of each case is as follows:

- **Run 1:** Oil Recovery 349 MBO

Produce wells H. J. Kuhn #15-R, 38 and Stark "B" #8. Inject CO2 into wells H. J. Kuhn #17, 42 and Stark "B" No. 10, and inject water into the Horizontal well. Distribute CO_2

separating the Main fault block area and the Kuhn #6 fault block was included to represent the silt-filled channel thought to be separating the two blocks. The new model also divides the reservoir into four layers, thus providing greater vertical heterogeneity and gravity effects than the original two layer model. Prediction runs focused upon the following issues:

- The effect of discontinuing CO_2 purchases on oil recovery.
- Improvements in areal sweep efficiency resulting from conversion of the Kuhn #42 well to a CO_2 injection well.
- Oil recovery potential from Kuhn #6 fault block.

To improve the prediction phase of this study, production from the Kuhn #6, #15-R, #33, #38 and Stark "B" #8 wells was continued until each well reached an oil rate equal to their actual current rate. This resulted in an additional 394 MBO produced from the reservoir prior to making prediction runs. This additional production was distributed as follows:

Well	Additional Oil Produced	Recent Test Used In Model
Kuhn # 6	4,000 BO	50 BOPD
Kuhn #15-R	13,000 BO	180 BOPD
Kuhn #33	212,000 BO	50 BOPD
Kuhn #38	4,000 BO	80 BOPD
Stark "B" #8	161,000 BO	50 BOPD

As can be seen from these numbers, the Kuhn #33 and Stark "B" #8 locations required the most adjustment to the oil saturation in order to match well performance. The most recent well test of 100% water on Kuhn #33 suggests that further refinements to the model can be made, but much of the optimism of the predictions has been removed. Prediction runs were made which focused upon production from Kuhn #15-R, #38 and Stark "B" #8.

Case Summary

A summary of the final prediction runs is described below. Wells Kuhn #15-R and #38 were given a maximum total fluid rate of 700 RB/D while Stark "B" #8 was set at 500 RB/D. A description of each case is as follows:

- **Run 1:** Oil Recovery 349 MBO

Produce wells H. J. Kuhn #15-R, 38 and Stark "B" #8. Inject CO2 into wells H. J. Kuhn #17, 42 and Stark "B" No. 10, and inject water into the Horizontal well. Distribute CO_2

already completed in the Marginulina reservoir, conversion of the well should be a relatively inexpensive project. This well will be capable of sweeping areas of the reservoir which currently are not being contacted by CO_2.

Results

Oil recovery volumes are for January, 1996 through December, 2008. An economic limit of 10 BOPD per well has been applied. Cases 5 through 8 show comparisons for cases 1 through 4 with an additional 1 year of CO_2 purchases.

Run	Producers	CO2 Injectors	Water Injectors	CO2 Purchases	Oil Recovery (MBO)
1	K15-R, K38, S8	K17, K42, S10	Horizontal	None	349
2	K15-R, K38, S8, K6	K17, K42, S10	Horizontal	None	693
3	K15-R, K38, S8, K6	K17, S10	Horizontal	None	619
4	K15-R, K38, S8	K17, S10	Horizontal	None	400
5	K15-R, K38, S8	K17, K42, S10	Horizontal	Buy 1 year	495
6	K15-R, K38, S8	K17, S10	Horizontal	Buy 1 year	502
7	K15-R, K38, S8, K6	K17, S10	Horizontal	Buy 1 year	833
8	K15-R, K38, S8, K6	K17, K42, S10	Horizontal	Buy 1 year	999

As can be seen from these results, substantial benefits result from additional CO_2 purchases for 1 year, particularly if the Kuhn #6 well is produced (compare run 2 & 8 and run 3 & 7). Much of this increase is attributable to higher CO_2 injection rates and higher pressure. Figures 9 through 12 graphically illustrate the above results. The benefits of additional CO_2 injection can only be justified if response is seen in the Kuhn #6, thus increasing the contactable reservoir volume. Figures 13 through 15 show the oil production rate, CO_2 production rate, and CO_2 injection rate for each of theses cases. Even though cases 1 and 4 show no substantial benefit from injecting CO_2 into Kuhn No. 42, it is recommended that this well be converted to a CO_2 injection well to improve areal sweep. This is based upon known weaknesses in the model and the potential for improving the areal sweep efficiency of the flood. Case 7 and 8 indicate the substantial impact Kuhn #6 can have upon production if it is produced during the CO_2 flood. Case 8 illustrates the benefit of injecting CO2 in Kuhn No. 42 and producing from Kuhn No. 6. There is considerable uncertainty associated with this fault block, and the upside potential could be excellent. Table 1 through 4 document the annual production and injection for all cases and can be used for economic evaluation.

FUTURE WORK

The history match of individual well performance for this model could be improved by making further adjustments to the oil-water relative permeability curve. Though this may improve the prediction for each well's future performance, it most likely will not affect the overall recoveries forecasted by the model. Premature water breakthrough in wells H. J. Kuhn #16 and #38 in the model indicates that the geology and/or oil-water contact in the vicinity of these wells should also be investigated to improve the prediction. The permeability of the silt-filled channel must also be reduced to prevent the breakthrough of CO_2 into the Kuhn #6 fault block. This model will be transferred to the Onshore Producing Division where improved monitoring of the CO_2 flood can be performed.

ACKNOWLEDGMENTS

The authors would like to thank Sami Bou-Mikael of the Onshore Producing Division for his assistance and guidance in this project.

Figure 1

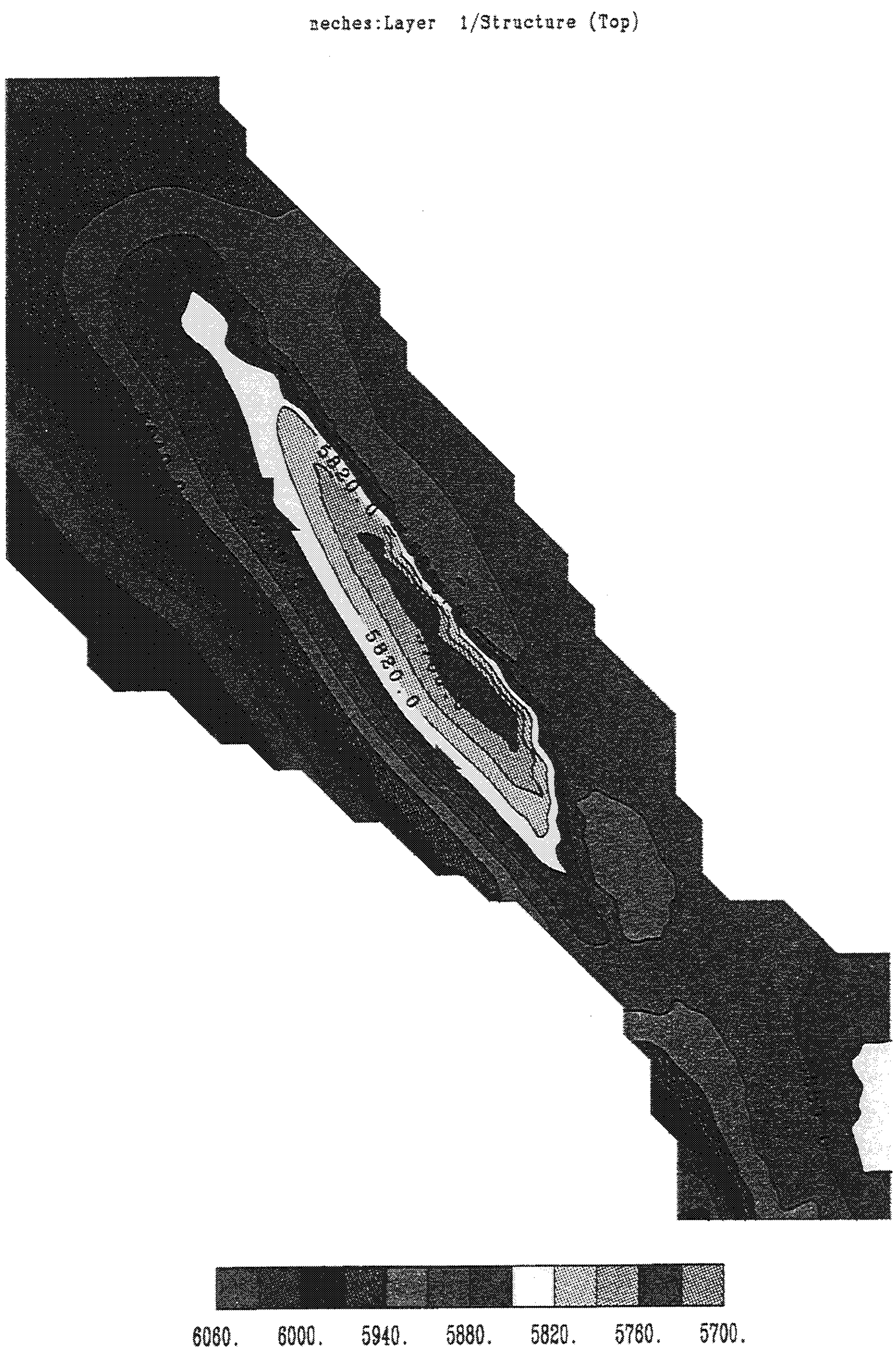

neches:Layer 1/Structure (Top)
5820.0
5820.0
6060. 6000. 5940. 5880. 5820. 5760. 5700.

Figure 2

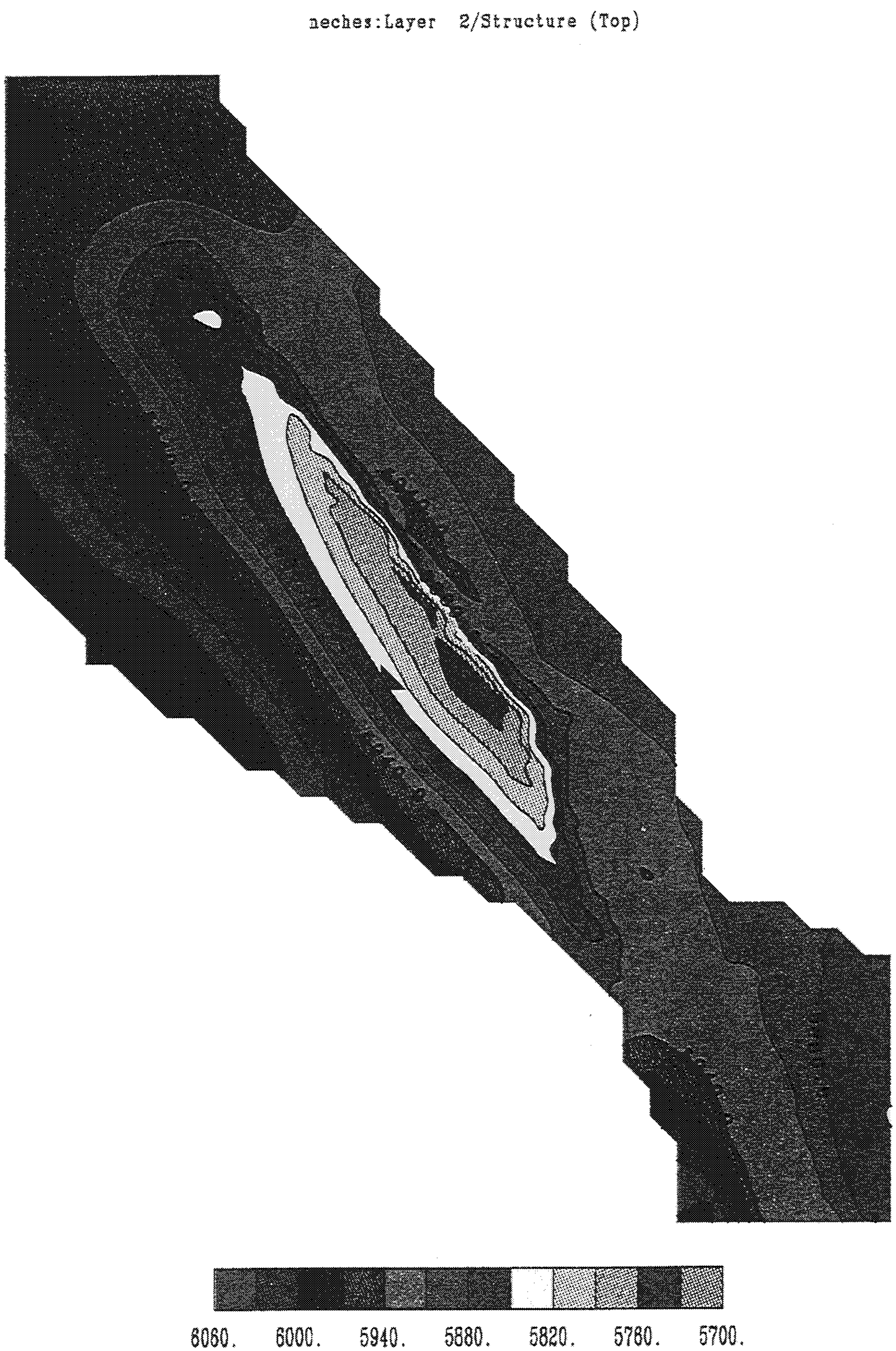

neches:Layer 2/Structure (Top)
6060. 6000. 5940. 5880. 5820. 5760. 5700.

Figure 3

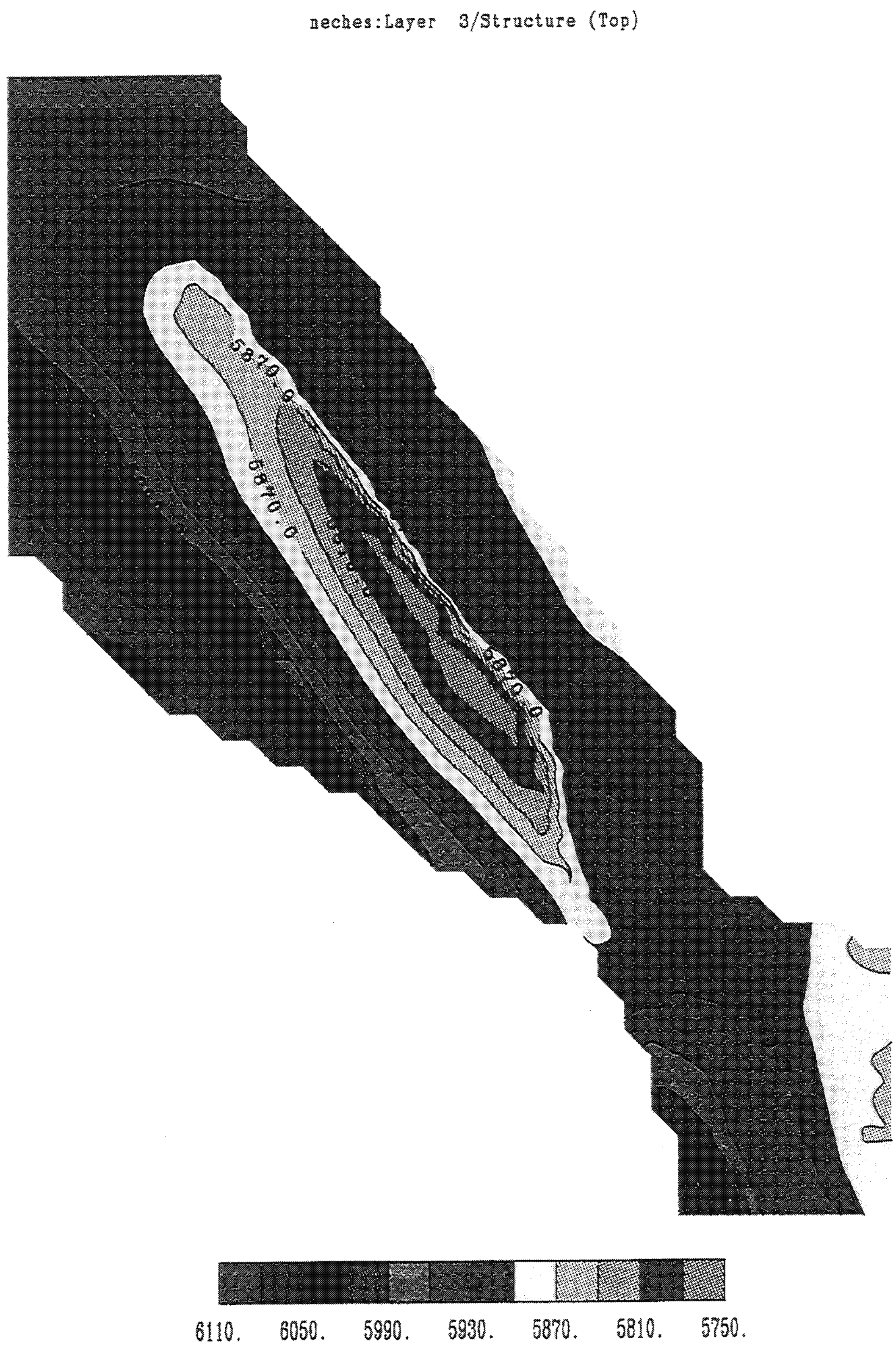

neches:Layer 3/Structure (Top)
5870.0
5870.0
5870.0
6110.
6050.
5990.
5930.
5870.
5810.
5750.

Figure 4

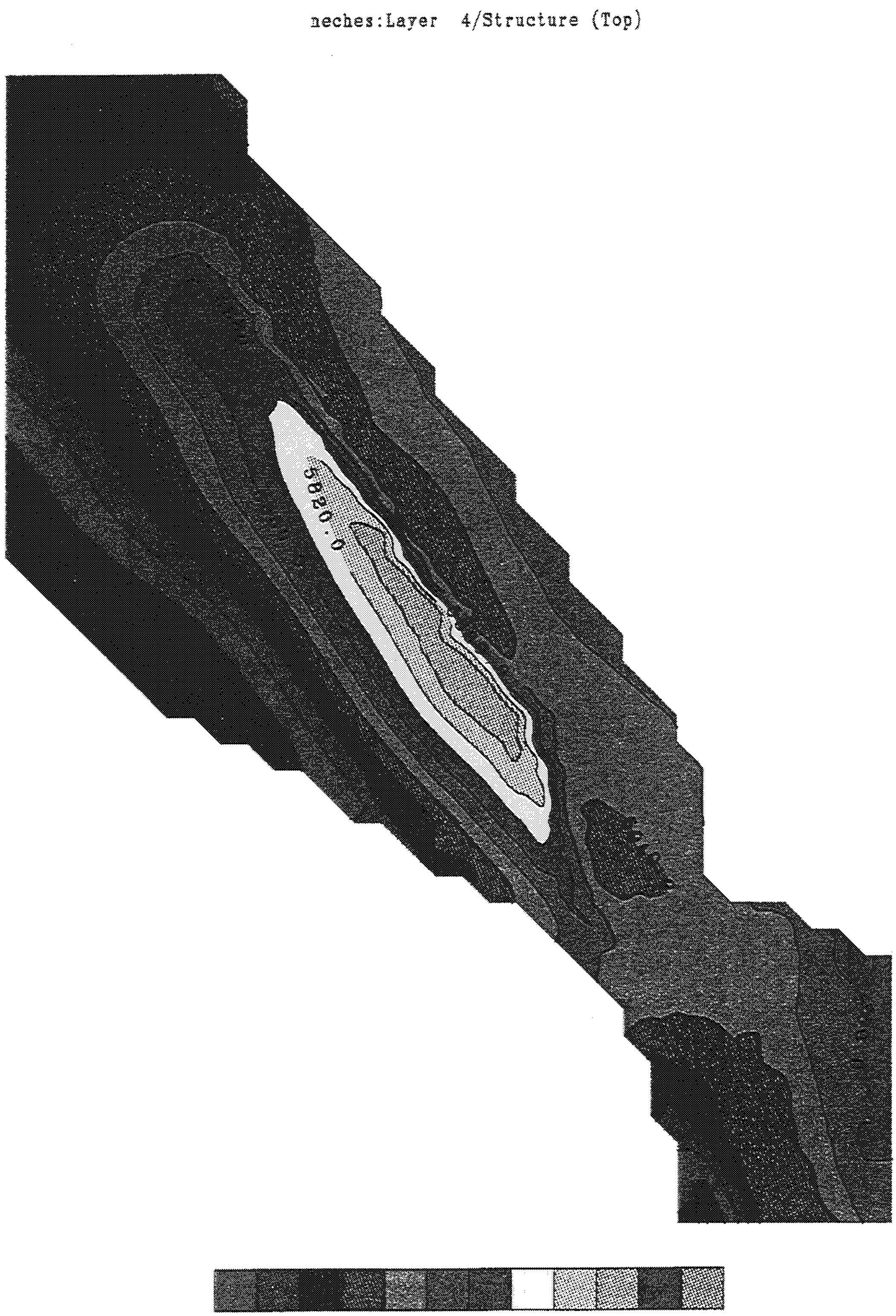

neches:Layer 4/Structure (Top)
5820.0
6060.
6000.
5940.
5880.
5820.
5760.
5700.

Figure 5

PORT NECHES FIELD

ORANGE COUNTY, TX

CO_2 PROJECT AREA

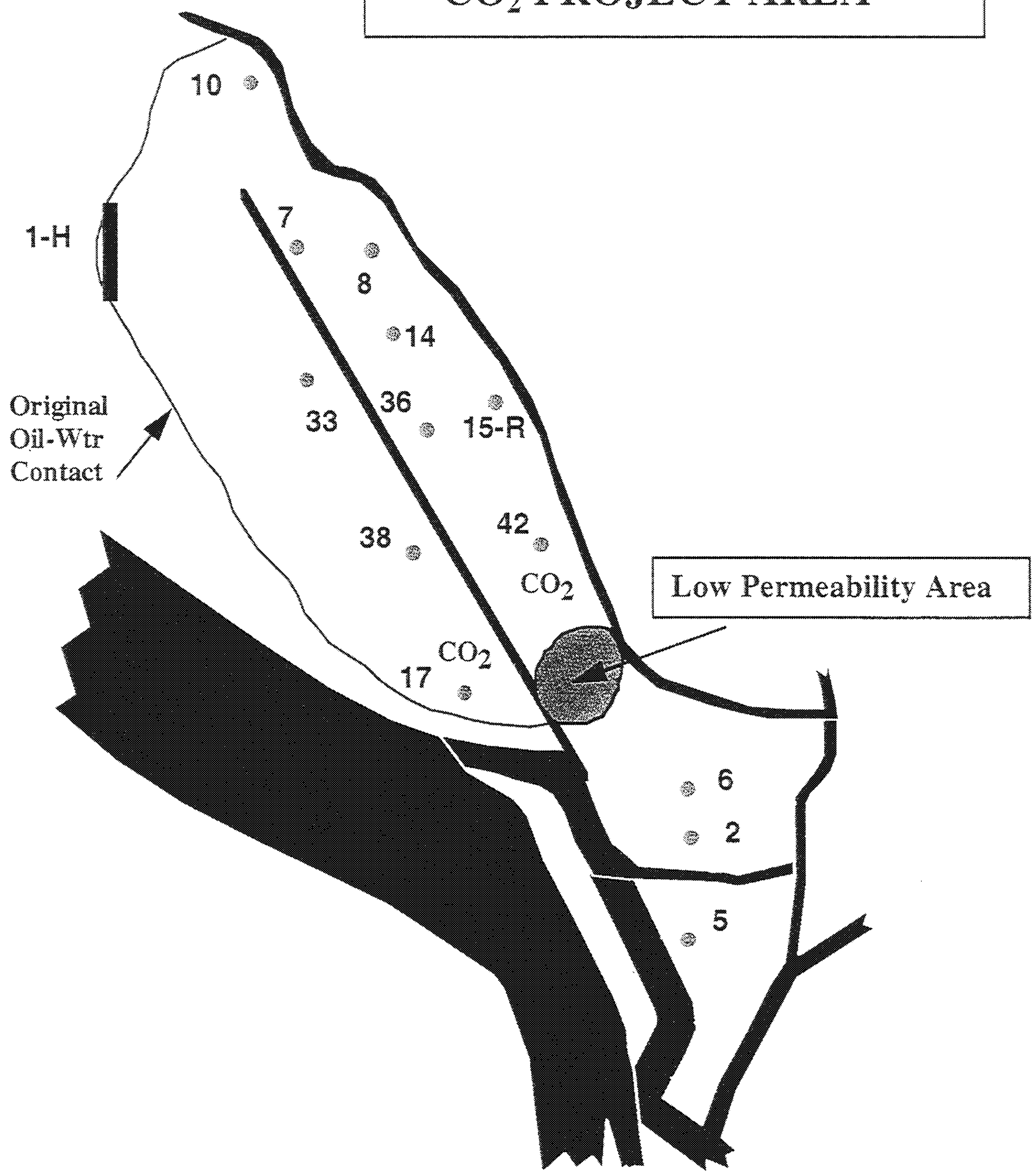
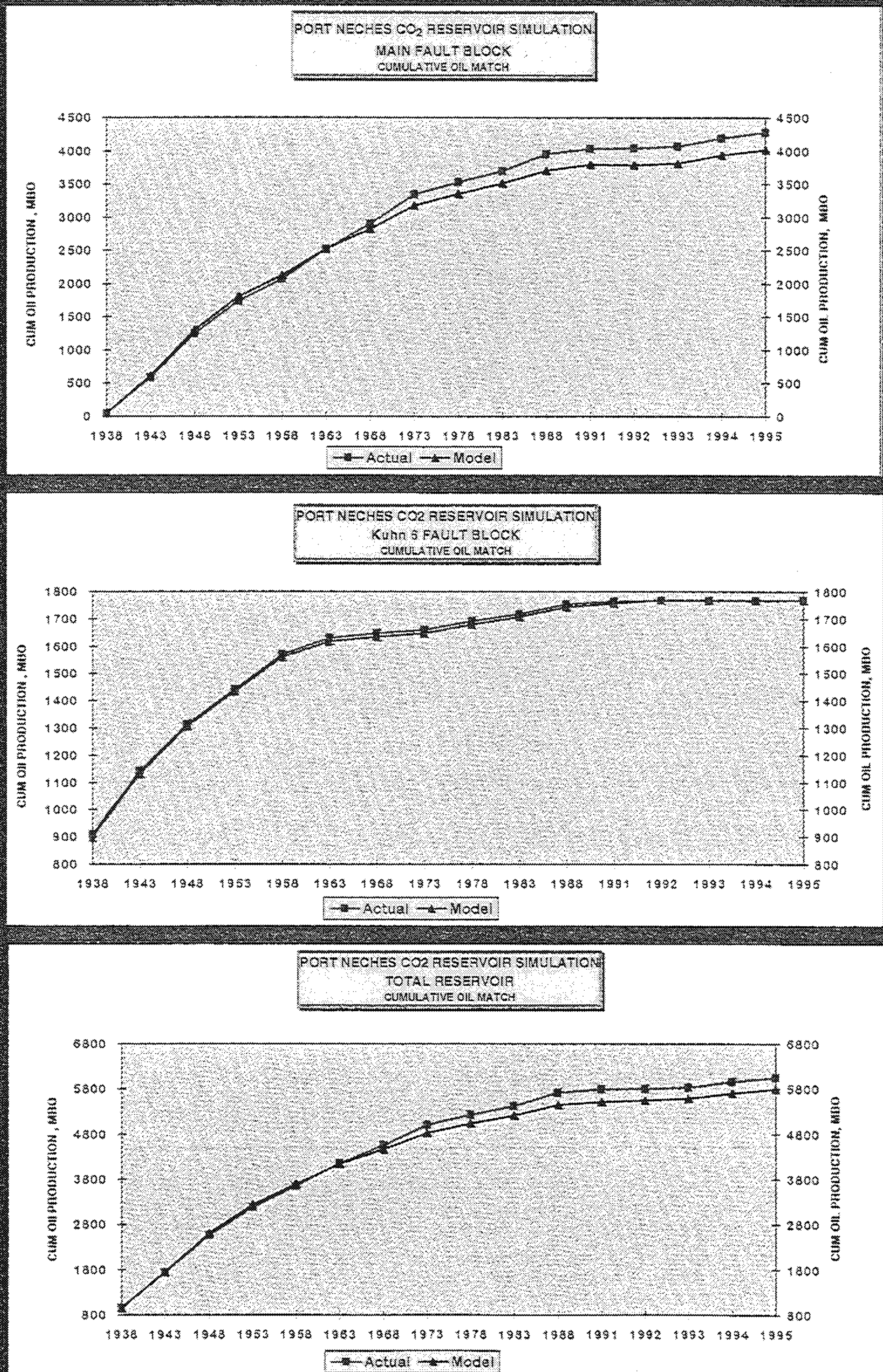


Figure 6


PORT NECHES CO_2 RESERVOIR SIMULATION
MAIN FAULT BLOCK
CUMULATIVE OIL MATCH
CUM OIL PRODUCTION , MBO
0 500 1000 1500 2000 2500 3000 3500 4000 4500
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual
Model
PORT NECHES CO2 RESERVOIR SIMULATION
Kuhn 6 FAULT BLOCK
CUMULATIVE OIL MATCH
CUM OIL PRODUCTION , MBO
800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual
Model
PORT NECHES CO2 RESERVOIR SIMULATION
TOTAL RESERVOIR
CUMULATIVE OIL MATCH
CUM OIL PRODUCTION , MBO
800 1800 2800 3800 4800 5800 6800
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual
Model

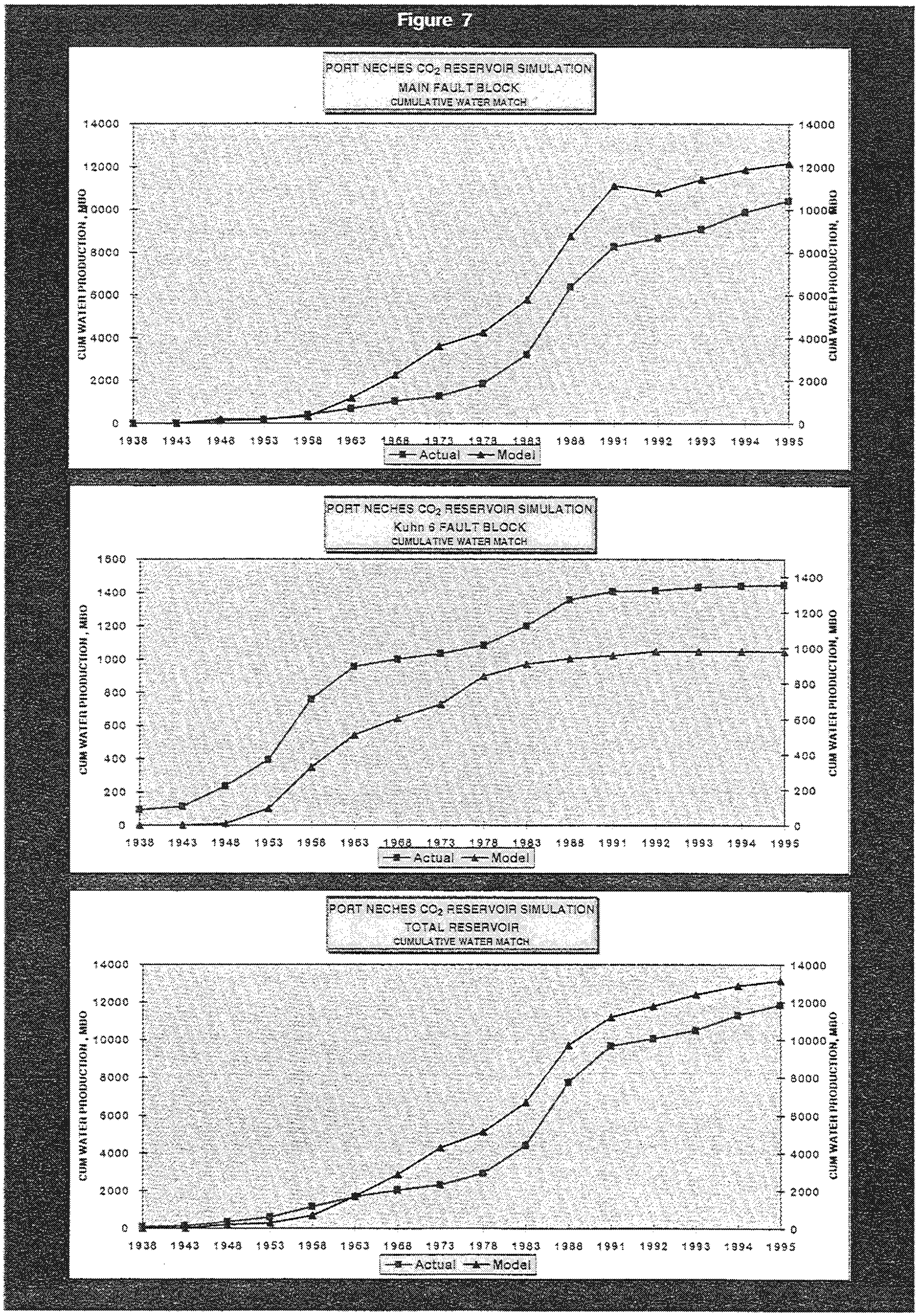
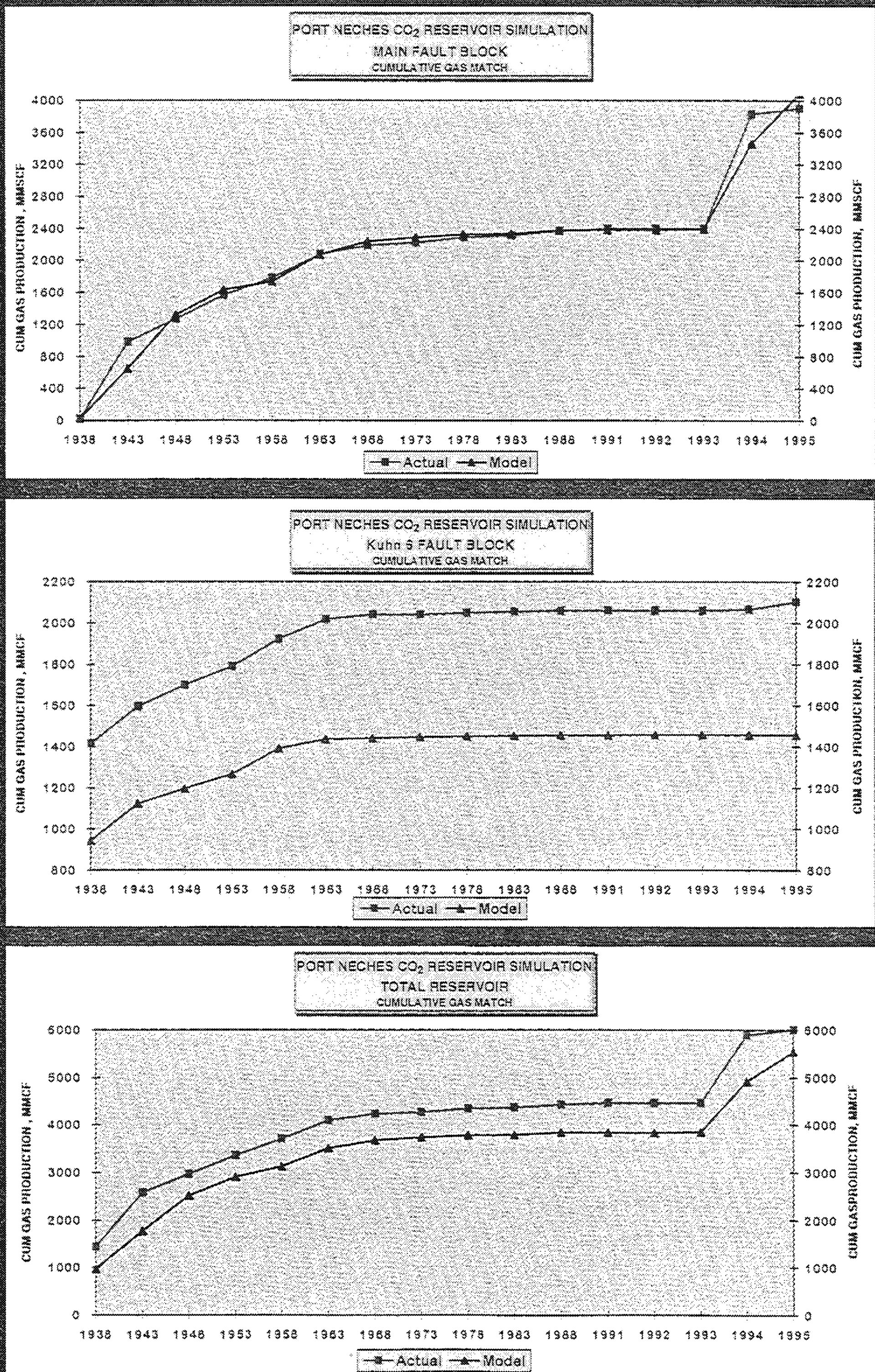


Figure 7
PORT NECHES CO2 RESERVOIR SIMULATION
MAIN FAULT BLOCK
CUMULATIVE WATER MATCH
CUM WATER PRODUCTION, MBO
Actual
Model
PORT NECHES CO2 RESERVOIR SIMULATION
Kuhn 6 FAULT BLOCK
CUMULATIVE WATER MATCH
CUM WATER PRODUCTION, MBO
Actual
Model
PORT NECHES CO2 RESERVOIR SIMULATION
TOTAL RESERVOIR
CUMULATIVE WATER MATCH
CUM WATER PRODUCTION, MBO
Actual
Model

Figure 8



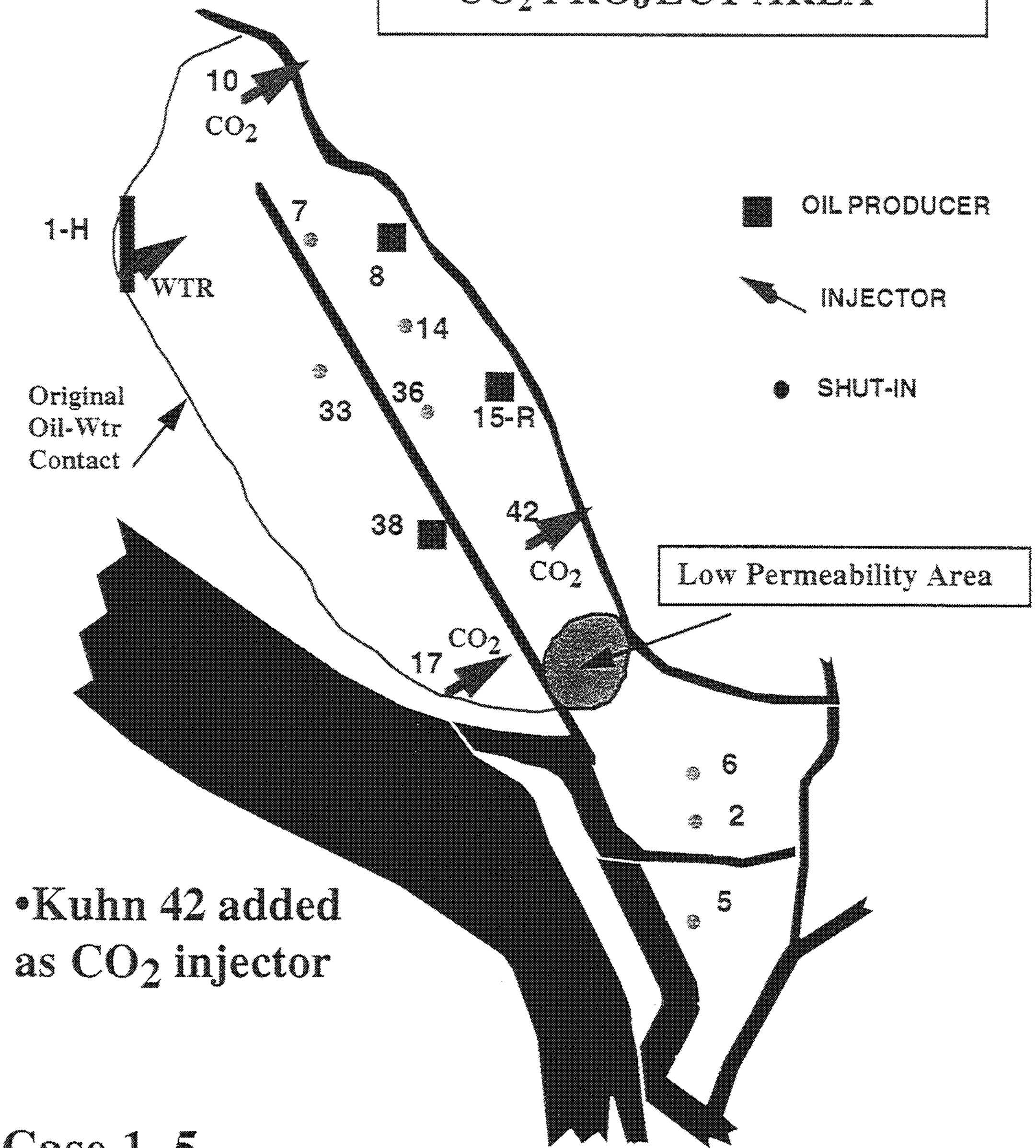
PORT NECHES CO_2 RESERVOIR SIMULATION
MAIN FAULT BLOCK
CUMULATIVE GAS MATCH
CUM GAS PRODUCTION , MMSCF
0 400 800 1200 1600 2000 2400 2800 3200 3600 4000
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual Model
PORT NECHES CO_2 RESERVOIR SIMULATION
Kuhn 5 FAULT BLOCK
CUMULATIVE GAS MATCH
CUM GAS PRODUCTION , MMCF
800 1000 1200 1400 1600 1800 2000 2200
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual Model
PORT NECHES CO_2 RESERVOIR SIMULATION
TOTAL RESERVOIR
CUMULATIVE GAS MATCH
CUM GAS PRODUCTION , MMCF
CUM GASPRODUCTION, MMCF
0 1000 2000 3000 4000 5000 6000
1938 1943 1948 1953 1958 1963 1968 1973 1978 1983 1988 1991 1992 1993 1994 1995
Actual Model

Figure 9

PORT NECHES FIELD

ORANGE COUNTY, TX

CO_2 PROJECT AREA



•Kuhn 42 added as CO_2 injector

Case 1, 5

349 MBO No CO_2 Purchase

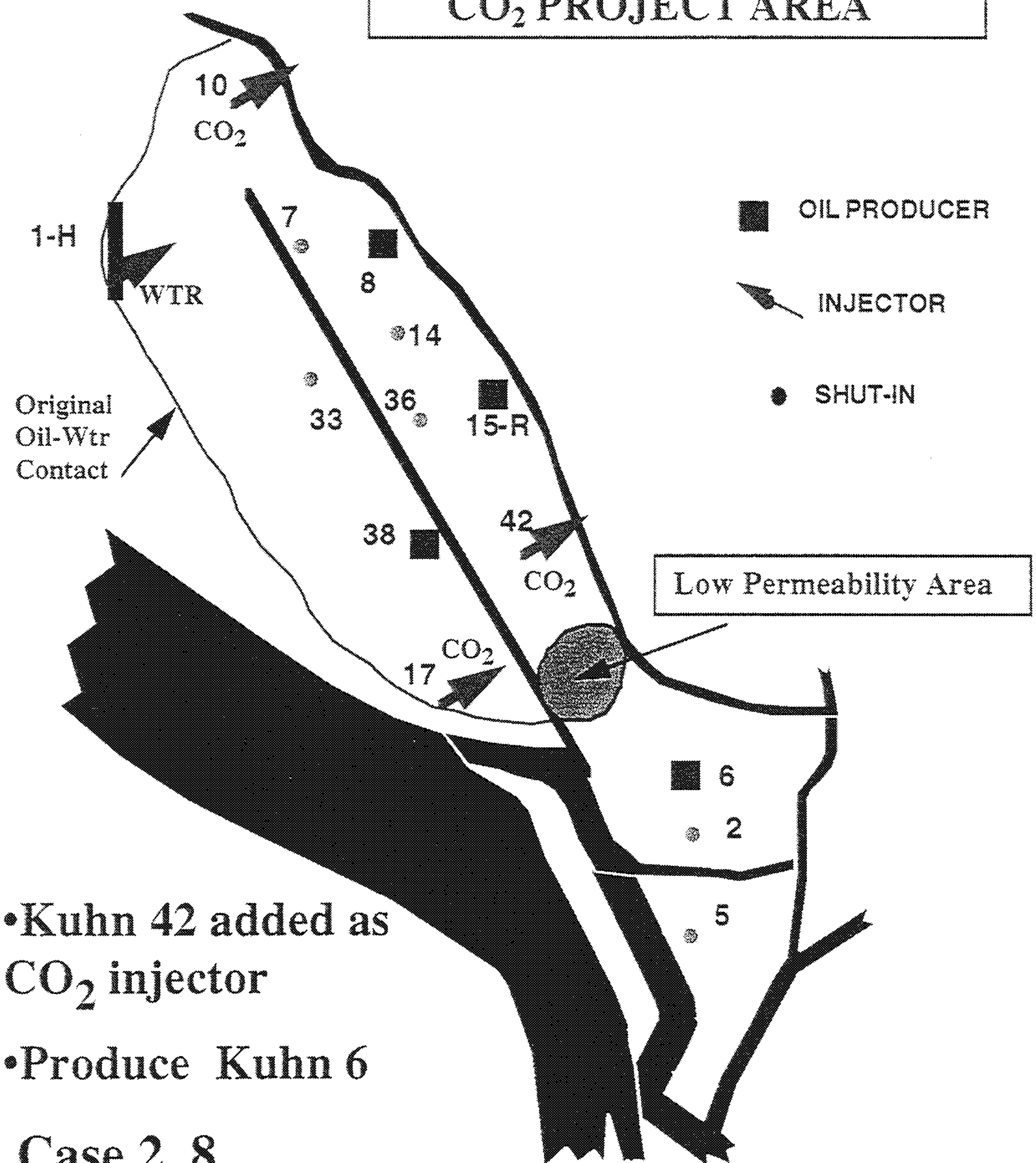
495 MBO Purchase CO_2 for 1 year

Figure 10

PORT NECHES FIELD

ORANGE COUNTY, TX

CO_2 PROJECT AREA



- Kuhn 42 added as CO_2 injector
- Produce Kuhn 6

Case 2, 8

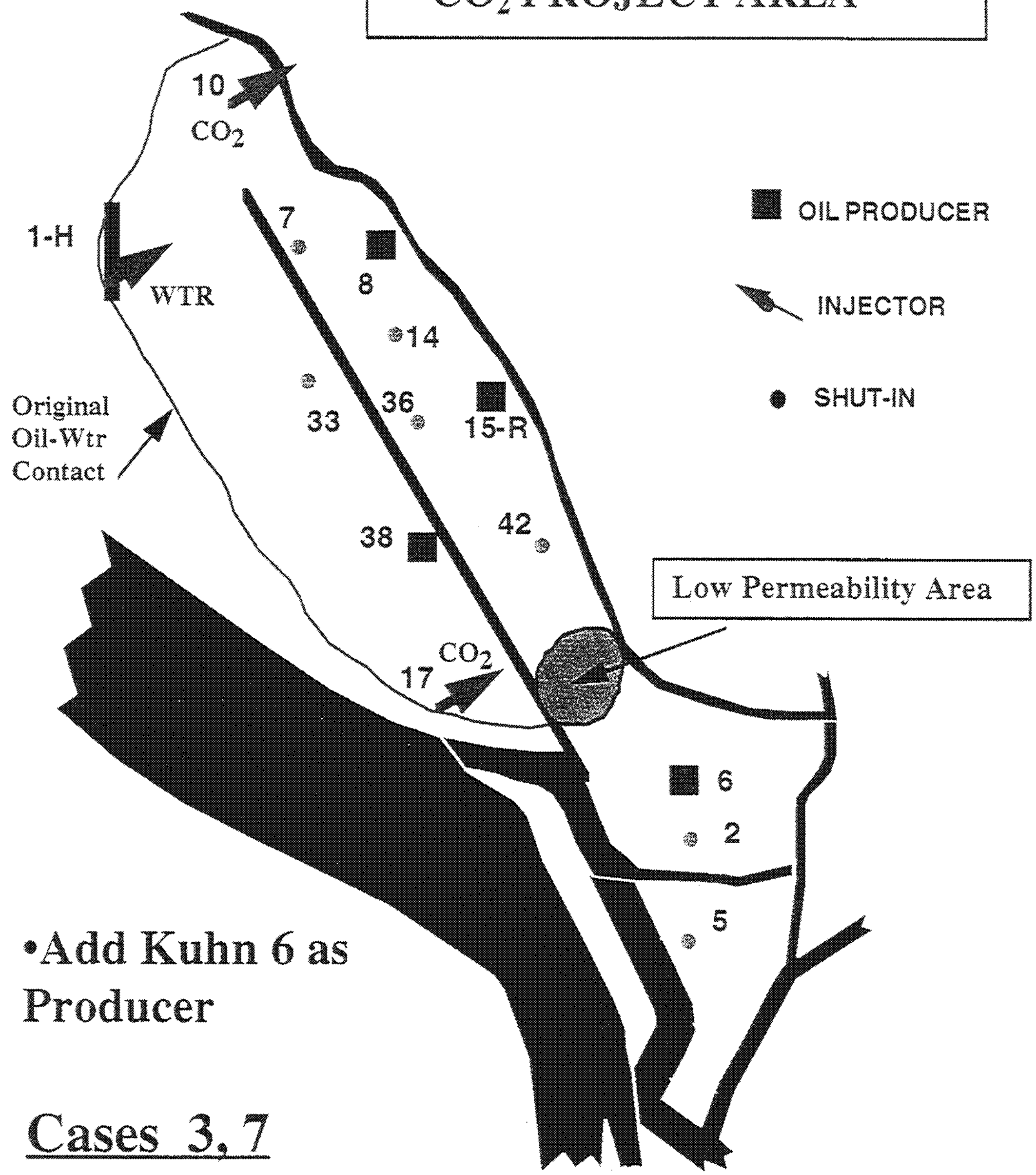
693 MBO No CO_2 Purchase
999 MBO Purchase CO_2 for 1 Year

Figure 11

PORT NECHES FIELD

ORANGE COUNTY, TX

CO_2 PROJECT AREA



•Add Kuhn 6 as Producer

<u>Cases 3, 7</u>

619 MBO No CO_2 Purchase

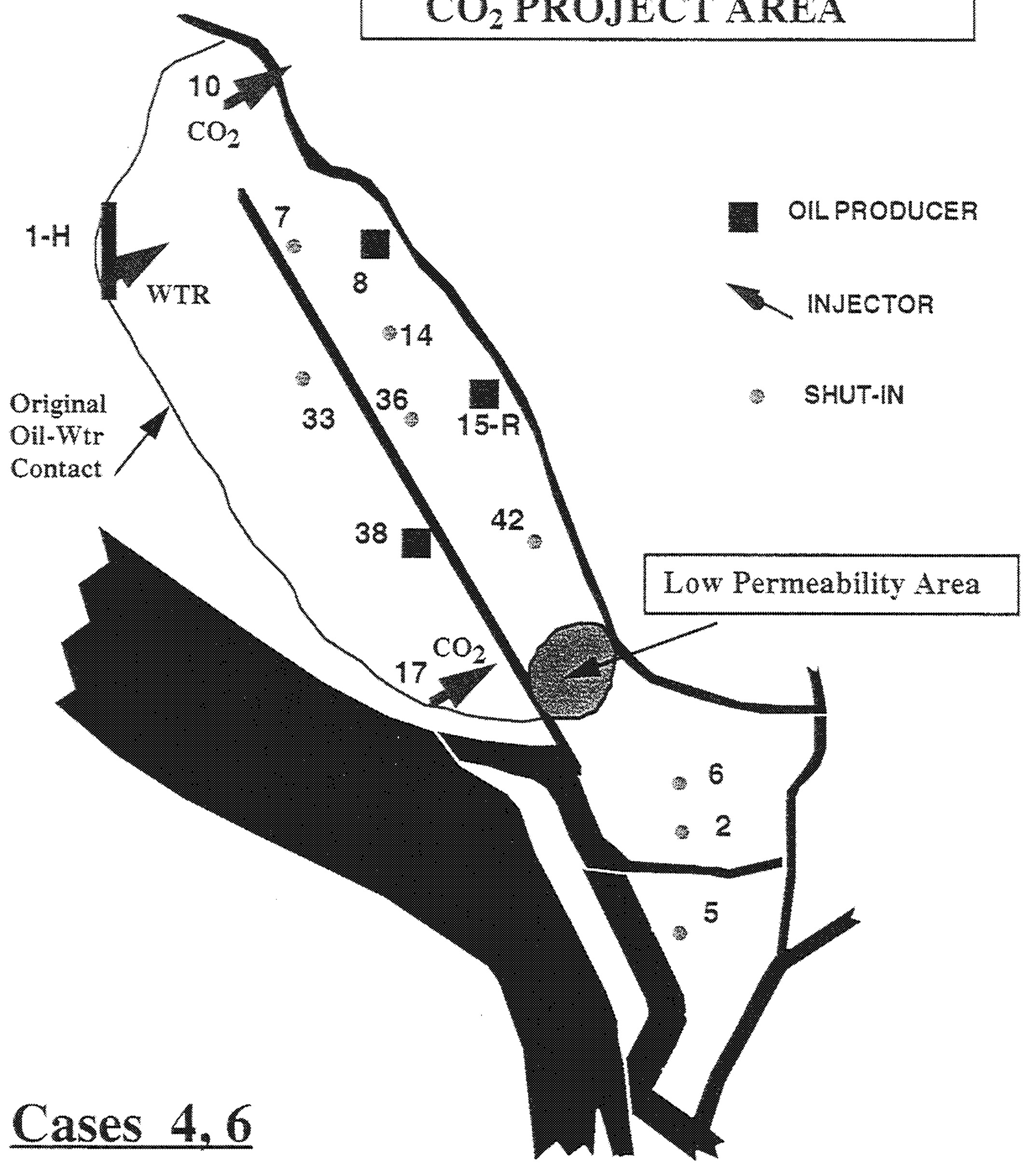
833 MBO Purchase CO_2 for 1 Year

Figure 12

PORT NECHES FIELD

ORANGE COUNTY, TX

CO_2 PROJECT AREA

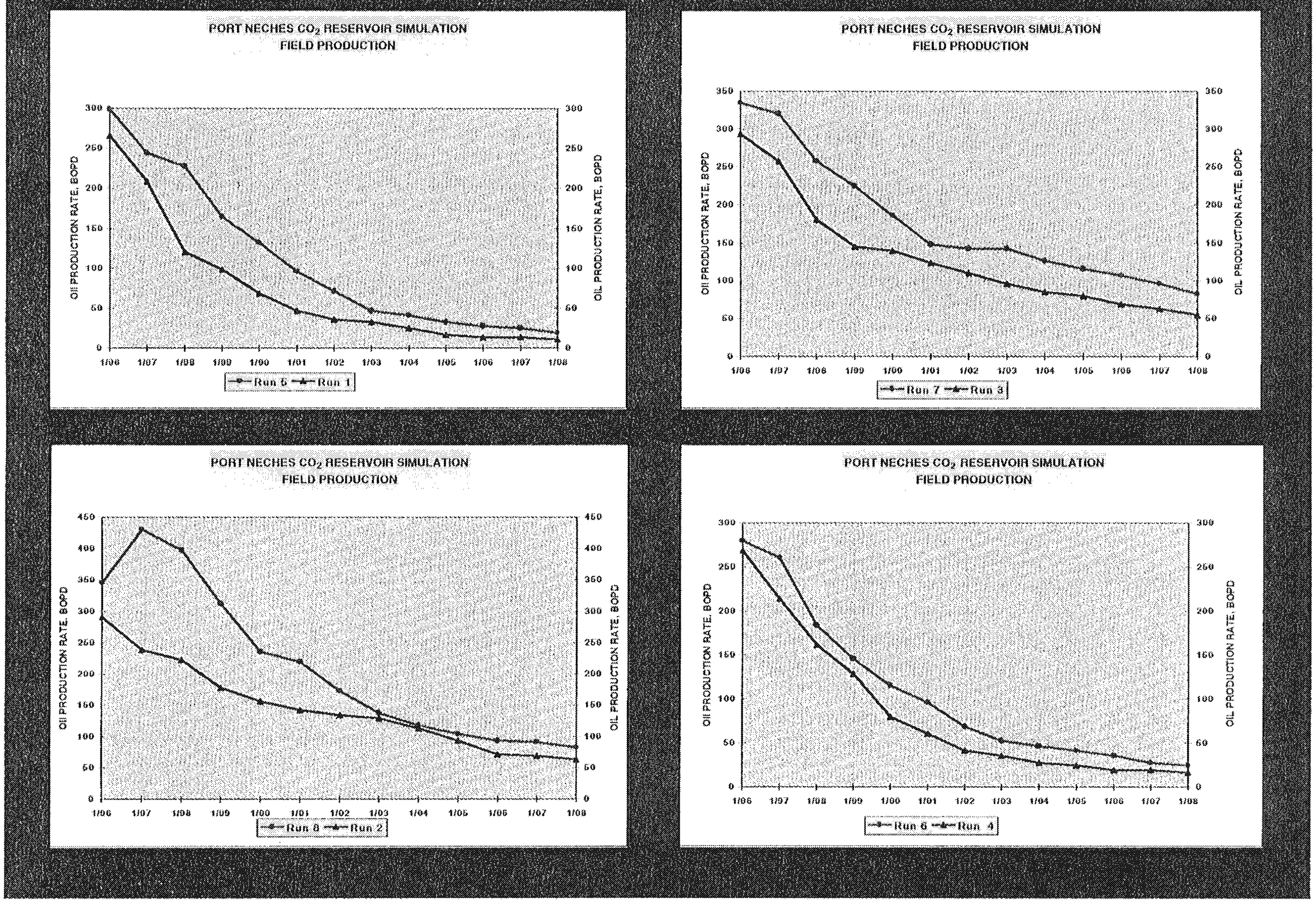


Cases 4, 6

400 MBO No CO_2 Purchase

502 MBO Purchase CO_2 for 1 Year

Figure 13


PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD PRODUCTION
Oil PRODUCTION RATE, BOPD
OIL PRODUCTION RATE, BOPD
1/06 1/07 1/08 1/09 1/00 1/01 1/02 1/03 1/04 1/05 1/06 1/07 1/08
Run 5
Run 1
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD PRODUCTION
Oil PRODUCTION RATE, BOPD
OIL PRODUCTION RATE, BOPD
Run 7
Run 3
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD PRODUCTION
Oil PRODUCTION RATE, BOPD
OIL PRODUCTION RATE, BOPD
Run 8
Run 2
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD PRODUCTION
Oil PRODUCTION RATE, BOPD
OIL PRODUCTION RATE, BOPD
Run 6
Run 4

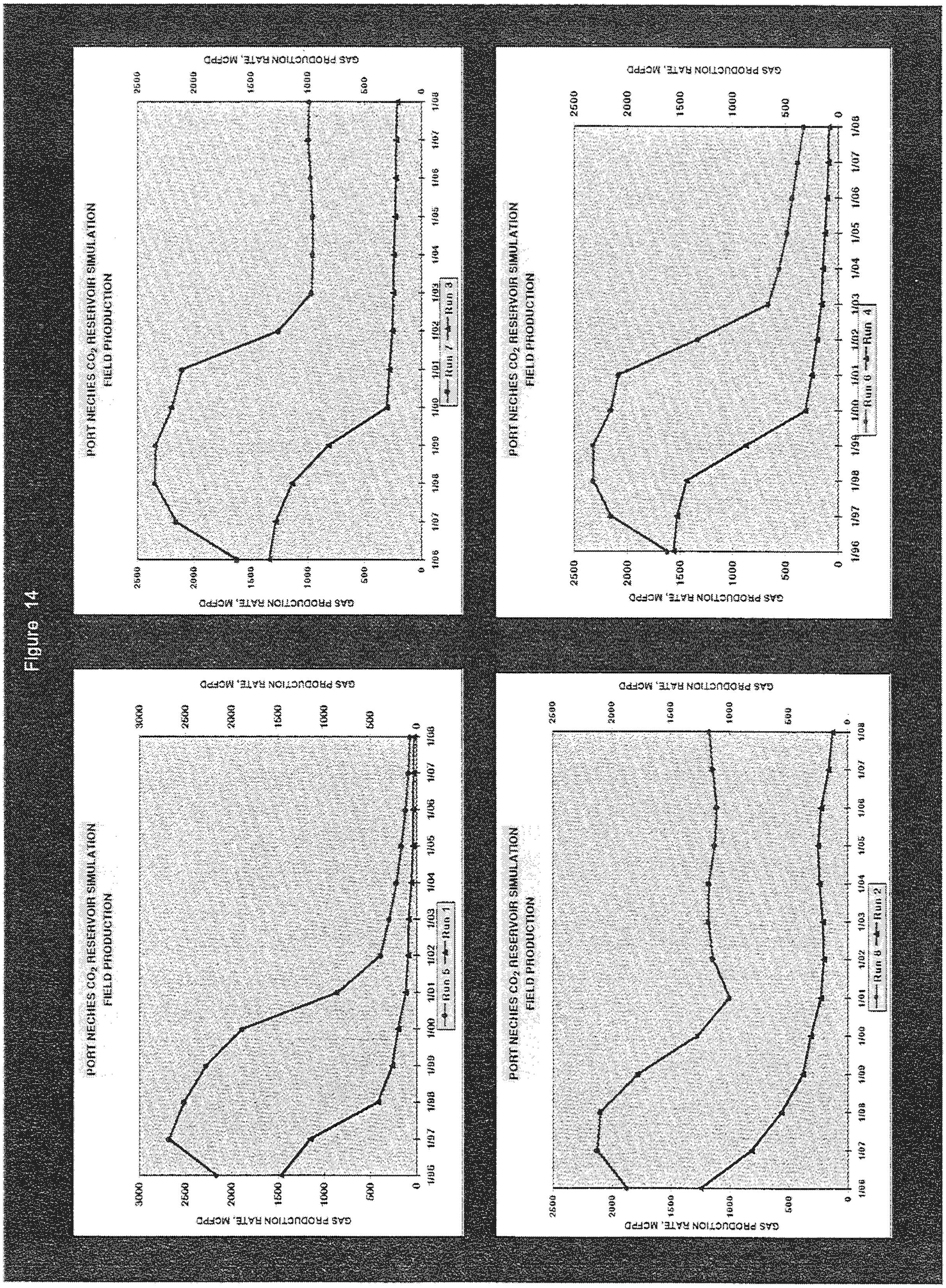
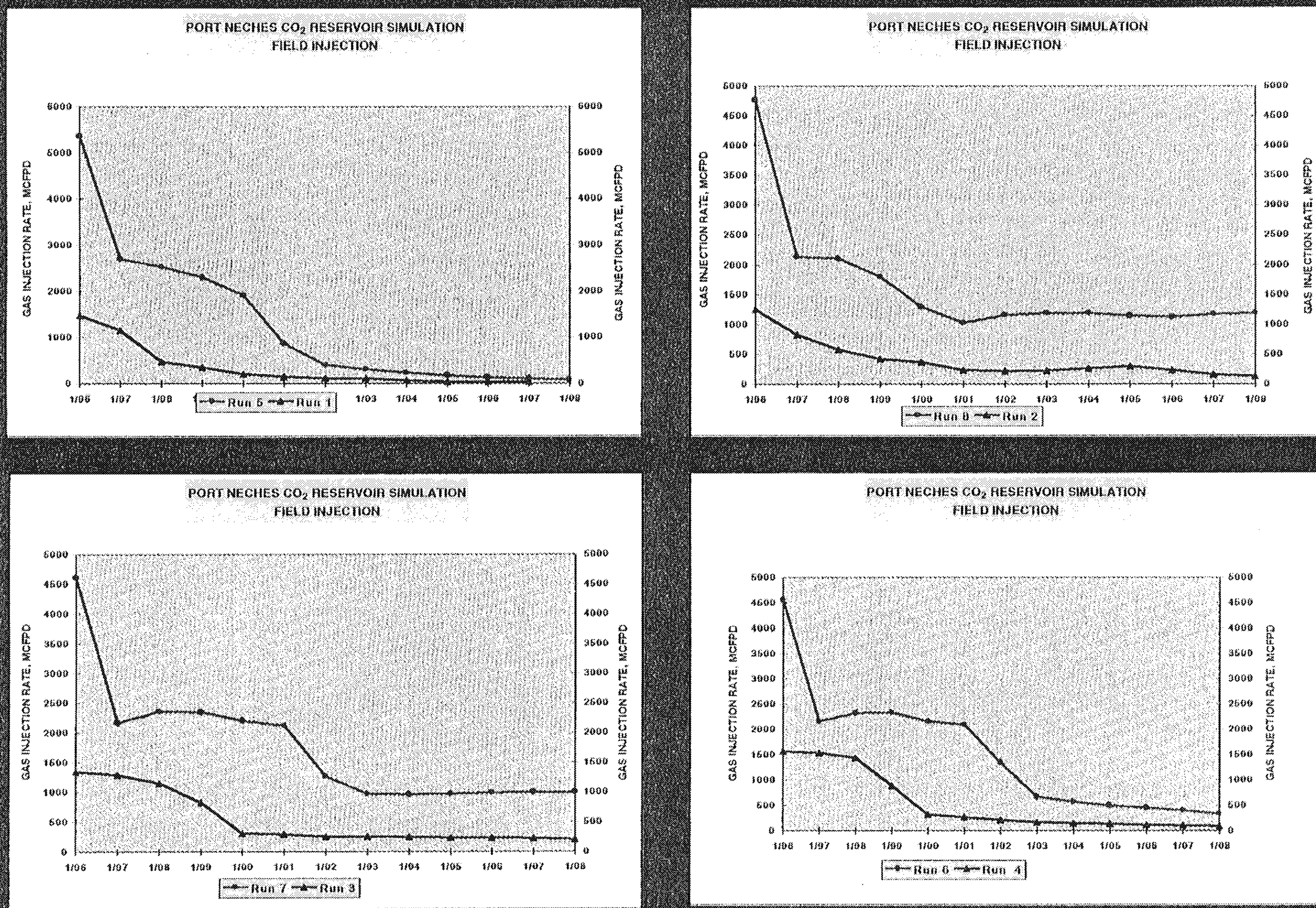

PORT NECHES CO2 RESERVOIR SIMULATION
FIELD PRODUCTION
GAS PRODUCTION RATE, MCFPD
Run 5
Run 1
PORT NECHES CO2 RESERVOIR SIMULATION
FIELD PRODUCTION
GAS PRODUCTION RATE, MCFPD
Run 7
Run 3
PORT NECHES CO2 RESERVOIR SIMULATION
FIELD PRODUCTION
GAS PRODUCTION RATE, MCFPD
Run 8
Run 2
PORT NECHES CO2 RESERVOIR SIMULATION
FIELD PRODUCTION
GAS PRODUCTION RATE, MCFPD
Run 6
Run 4
1/96 1/97 1/98 1/99 1/00 1/01 1/02 1/03 1/04 1/05 1/06 1/07 1/08

Figure 14

Figure 15


PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD INJECTION
GAS INJECTION RATE, MCFPD
Run 5
Run 1
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD INJECTION
GAS INJECTION RATE, MCFPD
Run 8
Run 2
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD INJECTION
GAS INJECTION RATE, MCFPD
Run 7
Run 3
PORT NECHES CO_2 RESERVOIR SIMULATION
FIELD INJECTION
GAS INJECTION RATE, MCFPD
Run 6
Run 4

Table

Table 1

PORT NECHES CO2 RESERVOIR SIMULATION PHASE I
ANNUAL PRODUCTION AND INJECTION

DATE	RUN 1			RUN 5		
	PRODUCTION		INJECTION	PRODUCTION		INJECTION
	MBO	MMCF	MMCF	MBO	MMCF	MMCF
1/96	97	535	538	109	791	1954
1/97	76	420	420	89	978	980
1/98	44	152	168	83	919	919
1/99	36	98	127	60	832	837
1/00	25	73	75	48	690	694
1/01	17	44	53	35	311	313
1/02	13	33	41	26	143	144
1/03	12	31	40	17	109	110
1/04	9	20	23	15	80	82
1/05	6	14	14	12	59	60
1/06	5	14	13	10	43	44
1/07	5	11	11	9	31	34
1/08	4	10	9	7	25	25

PORT NECHES CO2 RESERVOIR SIMULATION PHASE I
ANNUAL PRODUCTION AND INJECTION

DATE	RUN 2			RUN 8		
	PRODUCTION		INJECTION	PRODUCTION		INJECTION
	MBO	MMCF	MMCF	MBO	MMCF	MMCF
1/96	106	456	457	126	685	1736
1/97	87	298	299	157	776	777
1/98	81	206	210	145	765	766
1/99	65	139	153	114	650	654
1/00	57	115	133	86	466	468
1/01	52	84	85	80	367	370
1/02	49	74	79	63	417	419
1/03	47	78	81	50	432	432
1/04	41	87	94	43	430	431
1/05	34	91	109	38	412	414
1/06	26	82	83	34	405	408
1/07	25	58	58	33	418	424
1/08	23	47	47	30	429	432

Table 3

PORT NECHES CO2 RESERVOIR SIMULATION PHASE I ANNUAL PRODUCTION AND INJECTION						
DATE	RUN 3			RUN 7		
	PRODUCTION		INJECTION	PRODUCTION		INJECTION
	MBO	MMCF	MMCF	MBO	MMCF	MMCF
1/96	107	489	490	122	592	1680
1/97	94	468	469	117	788	788
1/98	66	415	418	94	858	858
1/99	53	298	300	82	854	855
1/00	51	111	112	68	801	801
1/01	45	103	104	54	770	771
1/02	40	93	92	52	459	459
1/03	35	90	92	52	353	353
1/04	31	88	87	46	349	349
1/05	29	84	86	42	349	350
1/06	25	82	83	39	355	357
1/07	23	81	81	35	363	363
1/08	20	78	76	30	360	361

PORT NECHES CO2 RESERVOIR SIMULATION PHASE I ANNUAL PRODUCTION AND INJECTION						
DATE	RUN 4			RUN 6		
	PRODUCTION		INJECTION	PRODUCTION		INJECTION
	MBO	MMCF	MMCF	MBO	MMCF	MMCF
1/96	98	569	570	102	591	1663
1/97	78	558	559	95	787	787
1/98	59	524	524	67	847	846
1/99	47	319	322	53	847	849
1/00	29	113	115	42	786	787
1/01	22	92	96	35	760	760
1/02	15	74	74	25	487	488
1/03	13	58	58	19	243	243
1/04	10	53	53	17	206	206
1/05	9	47	48	15	177	177
1/06	7	39	38	13	161	162
1/07	7	34	34	10	142	142
1/08	6	32	33	9	120	121

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Third Quarter, 1996

Executive Summary

Texaco is continuing to recycle CO_2 produced from the project area after terminating purchases from Cardox last March. Well Kuhn #15R remains the only producer in the project area after well Kuhn #38 sanded up. The well is currently producing 82 BOPD with 85 % water cut. No response has been observed in the other producing wells since we changed the injection pattern, particularly after initiating CO_2 injection in well Kuhn #42.

Third Quarter 1996, Objectives

* Continue to monitor and optimize reservoir performance.

Wells Kuhn #42 and Stark #10 continue to inject CO_2 at an average rate of 800 MCFD and 900 MCFD respectively with 1200 psi surface injection pressure. No significant response has been observed yet in the adjacent wells, at the same time production from Kuhn #15R declined from 125 to 82 BOPD. A workover is being prepared to replace the gravel pack setting in the well. Water injection is also continuing in wells Kuhn #17 and Marg Area 1-H at an average rate of 150 BWPD per well.

* Evaluate the effectiveness of the reservoir model.

The field performance differs to a certain extent from the reservoir simulator prediction. Two wells Kuhn #33 and Stark #8 have not seen any response from CO_2 injection as indicated by the model. We will continue to monitor and periodically test these two wells for CO_2 response. However, well Kuhn #38 was lost due to a mechanical problem with failed gravel pack setting. Injection will continue in the same pattern where wells Kuhn #42 and Stark #10 will be injecting recycled CO_2 and wells Kuhn #17 and Marg Area 1-H
will be injecting water to maintain reservoir pressure. We plan to evaluate the feasibility of performing a workover to re-perforate and gravel pack either Stark #8 or Kuhn #14. Both wells are in the CO_2 path between Stark #10 and Kuhn #15R and should have responded to fluid injection similar to Kuhn #15R.

Discussion of Results - Field Operations

The following is a list of the most recent well tests taken during the month of June 1996, for the producing and injection wells:

Producers:	Kuhn #15R,	82 BOPD,	77 % BS&W,	840 PSI,	22 CK
Injectors:	Kuhn #42,	784 MCFD,	1188 PSI,		
	Stark #10,	918 MCFD,	1182 PSI.		
	Kuhn #17,	131 BWPD,	1300 PSI.		
	Marg Area 1H,	181 BWPD,	1186 PSI.		

Discussion of Results - Technology Transfer

No other technology transfer activities has taken place since the technical paper presentation at the SPE/DOE Symposium in Tulsa last April.

Fourth Quarter 1996, Objectives

* Monitor reservoir performance.

* Evaluate the feasibility of two workovers in wells Kuhn #14 and Stark #8.

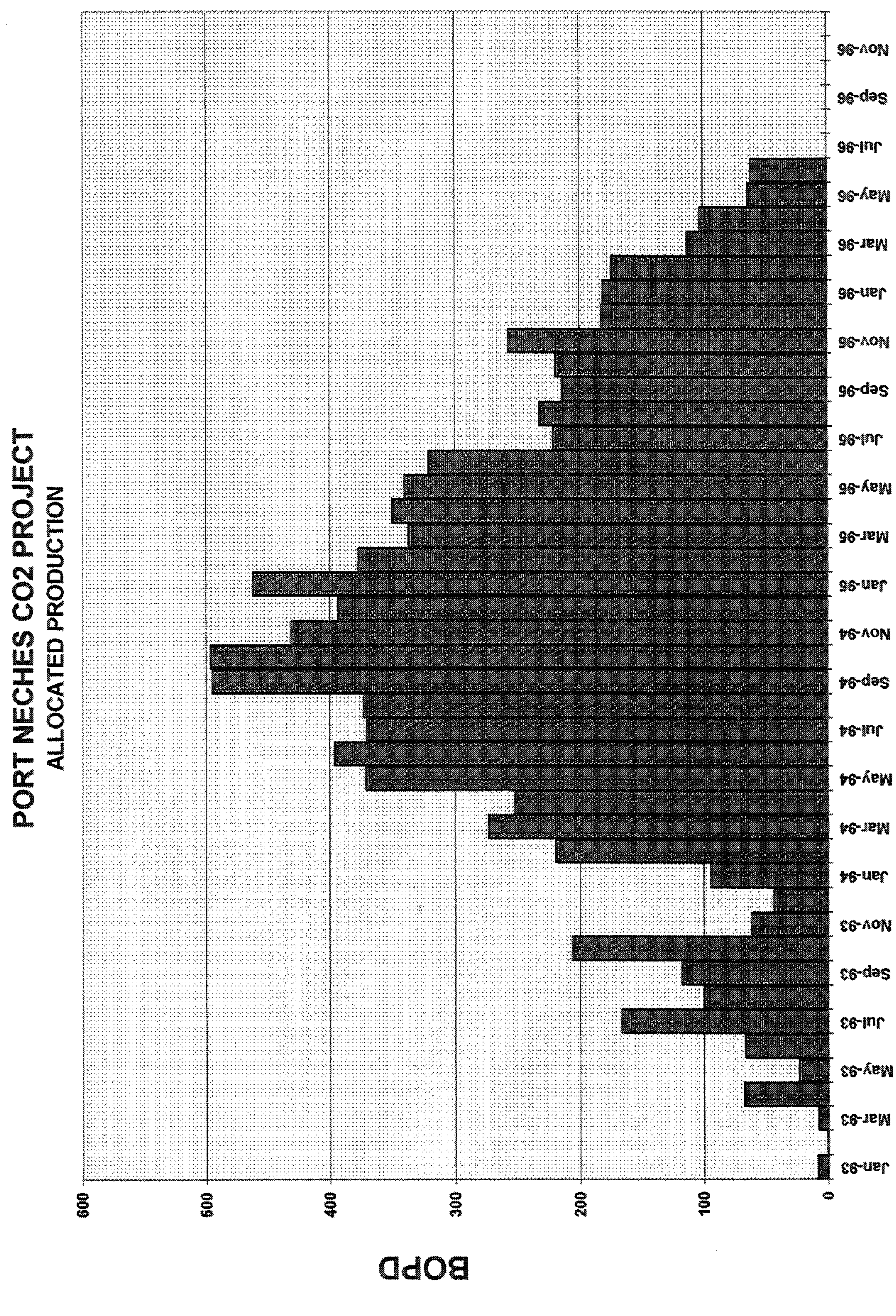
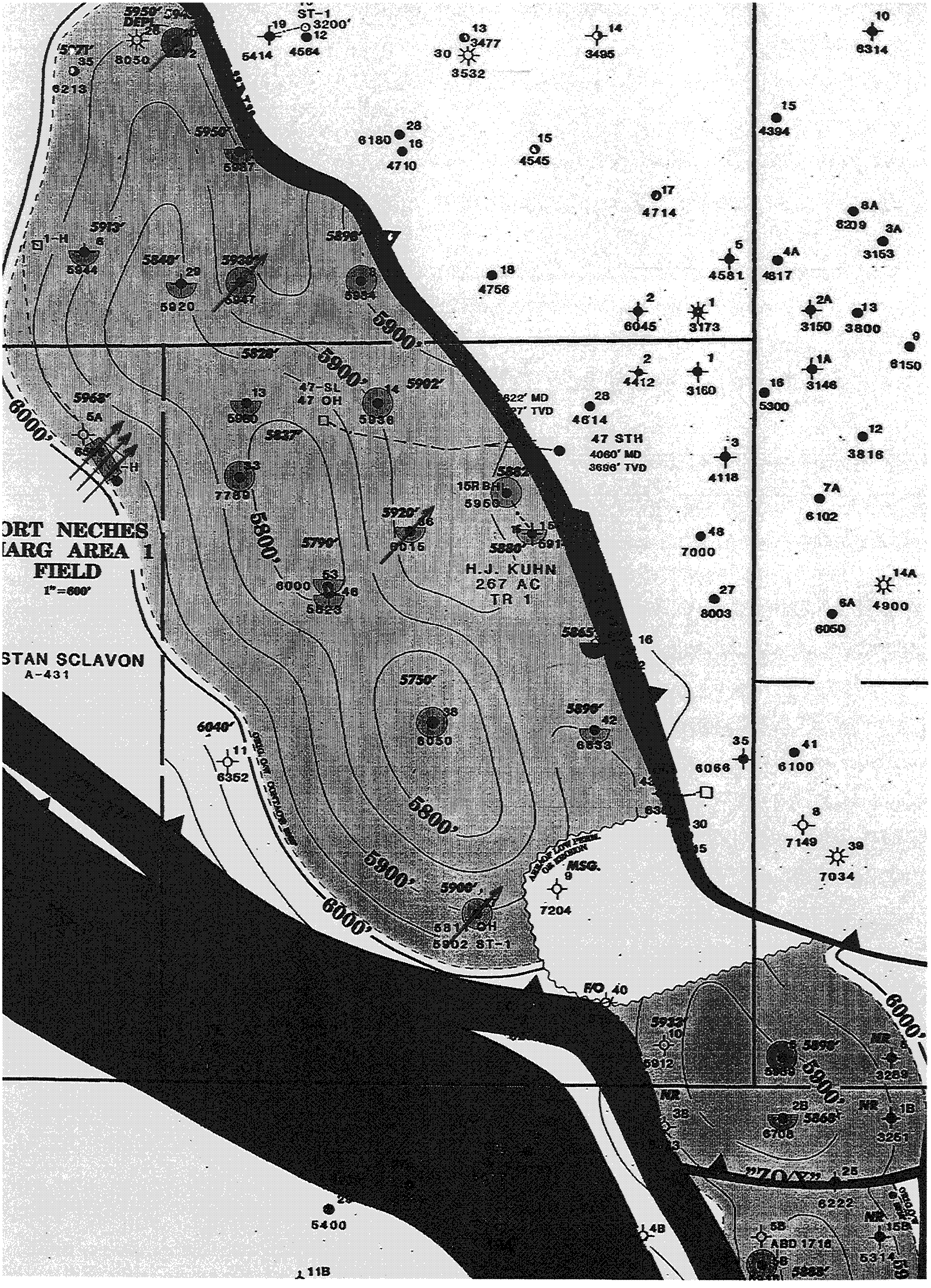

PORT NECHES CO2 PROJECT
ALLOCATED PRODUCTION
BOPD
0
100
200
300
400
500
600
Jan-93
Mar-93
May-93
Jul-93
Sep-93
Nov-93
Jan-94
Mar-94
May-94
Jul-94
Sep-94
Nov-94

Fig. 1



ORT NECHES
IARG AREA 1
FIELD
1" = 600'
STAN SCLAVON
A-431
H.J. KUHN
267 AC
TR 1
47-SL
47 OH
47 STH
4060' MD
3696' TVD
15R BH
5900'
5800'
6000'
5750'
MSG.
F/O
ABD 1716
ST-1

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER DE-FC22-93BC14960	2. PROGRAM/PROJECT TITLE CLASS I	3. REPORTING PERIOD 4/1/96 — 6/30/96
4. PARTICIPANT NAME AND ADDRESS Texaco Exploration & Production Inc. 400 Poydras St. New Orleans, LA. 70130	5. START DATE: 6-1-93	6. COMPLETION DATE 12-31-97

7. FY — 8. MONTHS: J F M A M J J A S O N D J F M

9. COST STATUS

a. $ Expressed in: THOUSANDS

b. Budget and Reporting No.: AC1510100

c. Cost Plan Date: 6-23-93

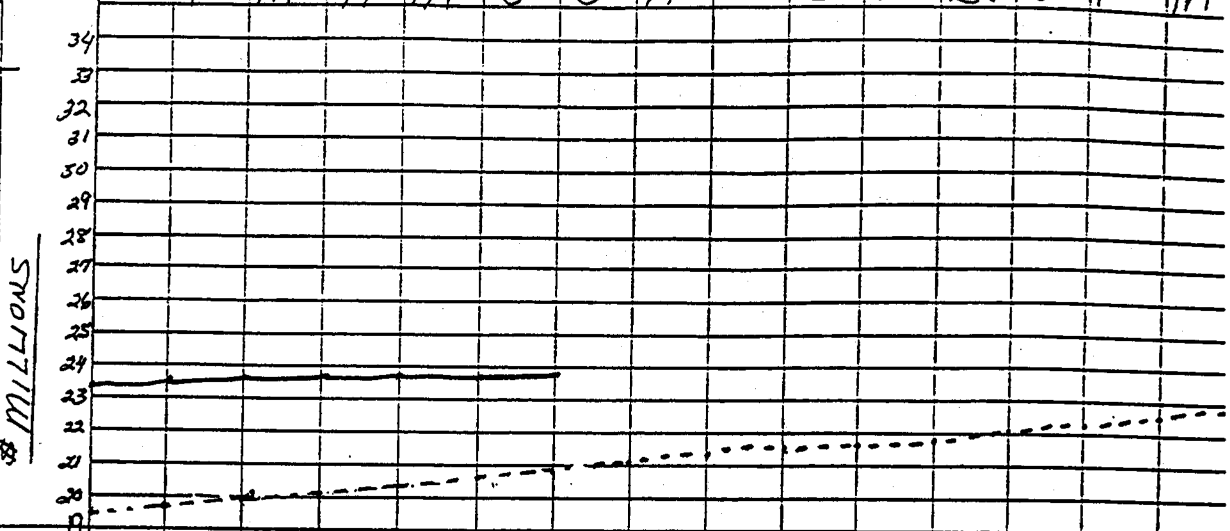
d. Actual Costs Prior Years: $23,417

e. Planned Costs Prior Years: 19,516

f. Total Estimated Cost for Contract: 10,085

g. Total Contract Value: 2,985

h. Estimated Subsequent Reporting Period



Accrued Costs		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
	h. Actual	46	51	65	54	60	147									
	i. Variance	164	159	145	156	150	63									
<867>	j. Cumulative Variance	<703>	<544>	<399>	<243>	<93>	<30>									

10. LABOR STATUS

a. Labor Expressed in: THOUSANDS

b. Labor Plan Date: N/A Direct Lbr

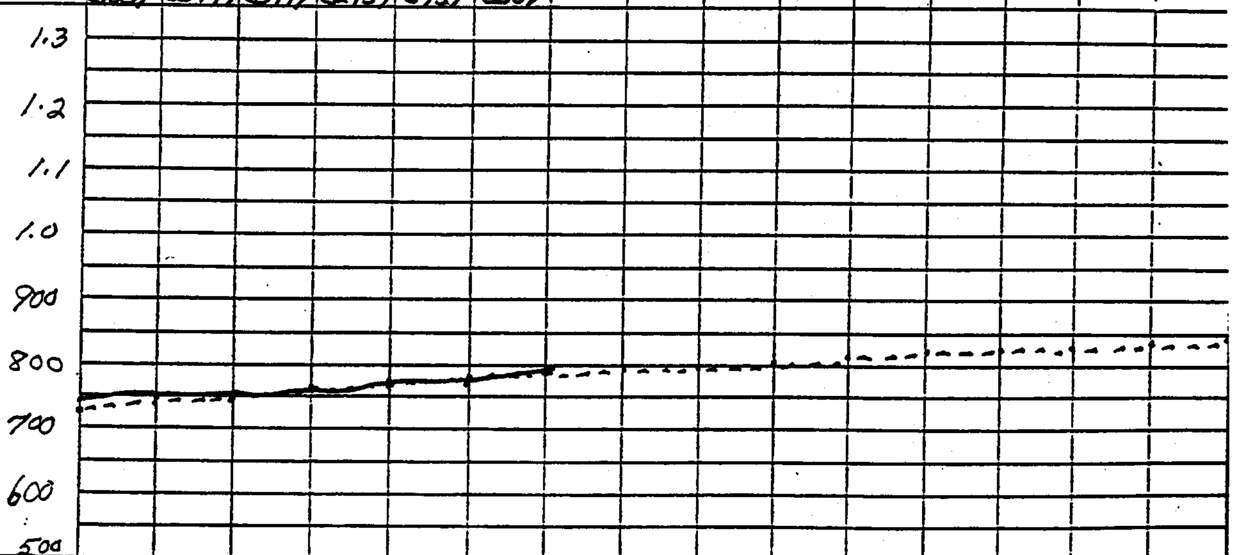
c. Planned Labor Prior Fiscal Years: $731

d. Actual Labor Prior Fiscal Years: $738

e. Total Estimated Labor for Contract: $465

f. Total Contract Labor: N/A

LEGEND
Planned: – – – – – –
Actual: ————
Projected: . . . .



Labor		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	h. Actual	0	9	4	5	7	22									
	i. Variance	7	<2>	3	2	0	<15>									
<2>	j. Cumulative Variance	5	3	6	8	8	<7>									

11. MILESTONES — STATUS — COMMENTS

a. – h.

Previous adjustment of <$46,778.88> to year ending Dec. 1995 has been made here. This info based on changing factors for 1995 actuals.

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

08/12/96

U.S. DEPARTMENT OF ENERGY
FEDERAL ASSISTANCE MILESTONE PLAN
OMB Burden Disclosure Statement

DOE F4600.3
(01-93)

FORM APPROVED
OMB NO. 1910-0400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Field test for cost effectiveness of water disposal in low pressured gas reservoirs	Apr 1, 1996 - June 30, 1996	DE-FG21-95MT32061

4. PARTICIPANT NAME AND ADDRESS
MVP PRODUCTION INC.
400 Poydras St.
New Orleans, LA 70130

5. START DATE
Sept. 30, 1995

6. COMPLETION DATE
Sept. 29, 1999

Program/Project Duration

Identification Number	Planning Category (Work Breakdown Structure Tasks)	1993 OCT	1993 DEC	1994 FEB	1994 APR	1994 JUN	1994 AUG	1994 OCT	1994 DEC	1995 FEB	1995 APR	1995 JUN	1995 AUG	1995 OCT	1995 DEC	1996 FEB	1996 APR	1996 JUN	1996 AUG	1996 OCT	1996 DEC	1997 FEB	1997 APR	1997 JUN	1997 AUG	
1.0	UIC Permit	A		B																						
2.0	Unitization	B		B																						
3.0	Workover Injection Well		A		B																					
4.0	Workover Producing Well		A		B																					
5.0	Injection/Flowline Installations				B																					
6.0	Water Injection				A																					
7.0	Gas Production							A																		
8.0	Reservoir simulation				A				B																	
9.0	SPE Paper											A						B								
10.0	Final Report																									A
11.0	Recording Monthly Production																									
12.0	Recording Monthly Injection																									

REMARKS

SIGNATURE OF RECIPIENT AND DATE

SIGNATURE OF U.S. DEPARTMENT OF ENERGY (DOE) REVIEWING REPRESENTATIVE AND DATE

123/DOEGRAPH.WK4

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Apr 1, 1996 - June 30, 1996**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No. 0348-0039	Page	of
U. S. Department of Energy	DE-FC22-93BC14960		1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	323037151	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
January 1, 1995	December 31, 1997	04-01-96	06-30-96

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$2,930,940.90	$264,373.51	$3,199,027.31
b. Recipient share of outlays	$1,887,232.85	$170,230.10	$2,059,853.68
c. Federal share of outlays	$1,043,708.05	$94,143.41	$1,139,173.63
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$1,043,708.05	$94,143.41	$1,139,173.63
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,940,890.95	($94,143.41)	$1,845,425.37

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box): [X] Provisional [ ] Predetermined [Final [ ] Fixed			
	b. Rate 94.17%	c. Base $33,369.45	d. Total Amount $31,424.01	e. Federal Share $11,190.09

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Sami Bou-Mikael - Project Manager	(504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted
	July 10, 1996

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

4. Federal grant or other identification number **DE-FC22-93BC14960**

5. Recipient's account number or identifying number **323037151**

6. Letter of credit number **NA**

7. Last payment voucher number **-**

Give total number for this period

8. Payment Vouchers credited to your account **-**

9. Treasury checks received (whether or not deposited) **0**

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year) **04/01/96**

TO (month,day,year) **06/30/96**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$0.00
	d. Total receipts (Sum of lines b and c)	$0.00
	e. Total cash available (Sum of lines a and d)	$0.00
	f. Gross disbursements	$0.00
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$0.00
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED 08/12/96
	TYPED OR PRINTED NAME AND TITLE Sami Bou-Mikael - Project Manager	TELEPHONE (Area Code, Number, Extension) (504) 593-4565

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)

Prescribed by Office of Management and Budget Cir. No. A-110

Ranking of Texas Reservoirs for Application of Carbon Dioxide Miscible Displacement

April 1996

Jerry Ham
Science Applications International Corporation
8301 Greensboro Drive
McLean, VA 22102

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Contents

Tables

Figures

1.0 Introduction

Injection of carbon dioxide (CO_2) into oil fields containing high-viscosity crude is one of the more successful enhanced oil recovery (EOR) techniques recently applied. CO_2 is injected into an oil field under high pressure to form a miscible bank of gases that decreases the viscosity of the oil. The process uses a concurrent, alternating, or subsequent injection of water to sweep the oil toward producing wells.

Active CO_2 miscible EOR projects have increased from just 17 in 1980 to 54 currently. Over the same period, EOR production from these projects has increased fivefold, from 21,532 to 161,486 barrels per day. Because of the existing infrastructure in the West Texas area, the number of miscible CO_2 enhanced oil recovery projects is expected to grow. The existing infrastructure makes the expansion of CO_2 into other nearby fields economically feasible.

Accompanying the rapid acceptance of the miscible CO_2 method by major oil and gas companies, a number of papers have been published in recent years that describe the properties exhibited by oil fields and reservoirs that make them amenable to the application of this technique. In 1992, Rivas et al., presented a paper at the Society of Petroleum Engineers (SPE) Latin-American Conference which proposed a method to rank reservoirs for the application of the CO_2 miscible EOR technique.[1] The ranking was based purely on technical merit and compared specific oil/reservoir systems to a set of optimum parameters. The parameters include API Gravity, oil saturation, reservoir pressure, temperature, the net oil column, reservoir dip, and porosity and permeability.

Under contract to the Department of Energy, Texaco commissioned the analysis described herein to determine the usefulness of CO_2 miscible flooding to oil fields in Texas. The analysis uses a methodology adapted by Louisiana State University from the paper published by Rivas et al., that automates the reservoir ranking process and adds an economic component. The report is intended to assist engineers with identifying candidate projects and to plan advanced recovery programs accordingly.

Many large oil companies have already developed their own screening criteria for evaluating and ranking producing properties. However, smaller companies do not have the resources or expertise to undertake such an evaluation and ranking. A major objective of this report is to generate interest among smaller and intermediate sized companies for using this EOR technique in their own fields. To this end, the report identifies fields that have a high probability of technical and economic success by applying a technical screen based on parameters from the Rivas paper and an economic screen based on a discounted cash flow analysis of each project. The report should also assist DOE staff to plan a proactive and targeted technology transfer campaign.

The technical screen developed by Rivas et al., showed that, on average the best reservoirs for carbon dioxide flooding should contain 36^0 API oil. The reservoir should also exhibit the following properties:

- a temperature of 150^0 F;
- a permeability of 300 md;
- an oil saturation of 60 percent;
- a reservoir pressure at the initiation of CO_2 injection about 200 psi greater than the minimum miscibility pressure;

- a porosity of 20 percent;
- a net sand thickness of 40 feet; and
- a reservoir dip of 20 degrees.

The technical screen was applied to the Texas reservoirs using the best and worst case parameter values specified in the paper by Rivas et al. An economic screen was then applied to the reservoirs remaining after the technical screen to identify projects that are economically as well as technically viable. The economic screen was based on a simple benefit/cost ratio computed using published field development costs and production potential for each project that passed the technical screen.

Of the 431 Texas reservoirs screened, 211 were found to be potentially profitable, with projected revenues exceeding costs. Only the top 154 reservoirs, however, showed a rate of return greater than 30 percent, while the top ten reservoirs predicted rates of return of at least 80 percent. Six of the top ten were Gulf Coast sandstone reservoirs.

1.1 Technical Approach

The ranking of the Texas oil reservoirs used an approach that was presented at the SPE Latin American Conference by Rivas et al., to screen Venezuelan heavy oil fields for the application of miscible CO_2-EOR techniques. This approach for ranking reservoirs was automated by Diaz at Louisiana State University and is the method used for this study.[2]

For this study, data on individual reservoirs were acquired for more than 400 large oil fields that currently account for more than 70 percent of annual Texas oil production. Almost half of the screened reservoirs are located in the Gulf of Mexico coastal region, in Texas Railroad Commission Districts one, two, three, and four. Reservoirs included in the study have produced on average about 10 million barrels each and have adequate geologic data available to perform the screening.

Piercement salt dome fields were excluded from the study because their complex structure, limited size, low well count, and high number make them significantly different from the reservoirs targeted for this study. Despite being beyond the scope of this study, it is recognized that these reservoirs also lend themselves to the application of the CO_2 enhanced recovery process.

Most of the physical data used in the technical screen are available for reservoirs in common units of measure. The minimum miscibility pressure (MMP), i.e., the lowest pressure at which about 95 percent of the contacted oil is recovered at a given temperature, is the exception. Oil and carbon dioxide are not generally directly miscible, but become so through the leaching of light hydrocarbons from the crude mixture. In other words the light hydrocarbons become gaseous. Reservoir temperature, oil composition, and carbon dioxide composition are all factors that determine MMP. Observable factors that can be used to determine MMP include:

1. MMP vs. temperature;
2. MMP vs. temperature and the molecular weight of C_{5+} (Pentanes and higher);
3. MMP vs. temperature and API gravity;
4. MMP vs. carbon dioxide density and C_{5+} composition;

5. MMP vs. detailed distribution of molecular size and structure;
6. MMP vs. API gravity, oil composition, and carbon dioxide purity.

Temperature and hydrocarbon distribution generally provide the most satisfactory predictions of MMP and are the most useful for initial estimates.

The remainder of the document is organized into the following sections:

Part 2.0 Field Application Review. Approximately 54 field/pilot projects are reviewed with major conclusions listed.

Part 3.0 Texas Reservoir Database. This data base was derived primarily from the hearings files of the Railroad Commission of Texas and is the one to which the technical and economic screens are applied.

Part 4.0 Screening Criteria. The technical screening model is described, sources of carbon dioxide by Texas County are presented, major assumptions are listed, and the results of the economic screen are discussed.

Part 5.0 Conclusions.

2.0 Field Applications Review

The Oil and Gas Journal reports that there are 54 active miscible carbon dioxide projects active in the United States, and this number is expected to grow.[3] Encouraging field results together with knowledge gained from ongoing projects have contributed to this growth. Recent innovations in miscible CO_2 recovery implemented by the oil industry are summarized by Diaz.[4] They describe intensive investment in infrastructure to develop and transport carbon dioxide to the main producing regions. The main region of CO_2-EOR application is currently the Permian Basin of New Mexico and West Texas, using carbon dioxide transported via pipeline from the McElmo Dome and Sheep Mountain Reservoirs in the Rockies and Bravo Dome in Mississippi. CO_2-EOR projects are also in progress in Mississippi and Louisiana, with CO_2 transported from the Jackson Dome (Mississippi). Oklahoma CO_2-EOR projects use CO_2 obtained from a fertilizer plant located in Enid, OK, while in the Texas Panhandle, CO_2 is supplied by the Labarge Gas Processing Facility operated by Exxon.

2.1 Miscible Field and Pilot Projects

A good compilation of information about projects involving displacement with carbon dioxide in sandstone reservoirs is provided in Hadlow, R.E., "Update of Industry Experience with CO_2 Injection" (1992); Goodrich, J. H., "Review and Analysis of Past and Ongoing Carbon Dioxide Injection Field Tests," (1980); Brock, W. R. and Bryan, L. A., "Summary Results of CO_2-EOR Field Tests, 1972-1987," (1989); and Mungan, N., "An Evaluation of Carbon Dioxide Flooding," (1991). To facilitate the analysis a comparison of several projects with all the information obtained from published sources is summarized in Table 2.1.1. The following conclusions were drawn from a close analysis of the information presented in Table 2.1.1.

- Miscible CO_2 injection is a reliable enhanced oil recovery method because numerous field tests have yielded considerable knowledge about the process. Process design parameters have been established and prediction techniques have been improved. Cost estimates are more reliable and CO_2 is more easily accessible than in the early years of the process. In addition, specialized equipment and techniques are now commercially available.

- Recovery results are encouraging, even though it is difficult to precisely quantify the expected final recovery due to the fact that many projects are still under development.

- Miscible CO_2-EOR has worked well in waterflooded and primary depleted reservoirs, and in reservoirs with wide ranges of original oil-in-place (OOIP). However, the remaining oil saturation in a reservoir must be high enough to justify the miscible displacement technique.

Table 2.1.1. Summary of Field and Pilot Applications of the Carbon Dioxide Miscible Displacement in Waterflooded Sandstone Reservoirs (Ref. 3,34-55) (Continued)

Field	So start %	So end %	Total Prod. b/d	Enh. Prod. b/d	Project Eval.	Profit	Project Scope	Ref.	OOIP MMBls	Swc %	Net Pay Feet	Space Acres/ Well	CO_2 Inj. Mmscf/ day	MMP psi	Gross Mscf/ bbl	Net Mscf/ bbl	CO_2 Source
Lost Soldier	45	36	7228	6464	Succ.	Yes	FW	3,34,35			28	10			13		Shute Creek Plant
Wertz	25	13	4699	2749	Succ.	Yes	FW	3,36	105.0		236	10	76.0	2350	15-19		Shute Creek Plant
North Ward Estes	25	10	2300	1200	Disc.		FW (Exp. UL)	3,37	1280.0	50	112	20	195.0	937	12	4.0	C02 Dome
Rangely Weber Sand	38	26	26000	16000	Succ.		FW	3,38,39	1578.0	28	250-300	20	170.0	3000	12-17	3-8	Shute Creek Plant
Ford Geraldine	41	35	1300	1300	Succ.	No	FW	3,40,41	83.0	35	25	40	20.0	900	10	6.0	Gas Plant, CO_2 domes
Twofreds	50		680	680	Succ.	Yes	FW	3,42-44	51.0	43	25	40	9.0	2330	12	9.6	Mivida gas plant
Northeast Purdy Unit	46	40	3200	2200	Succ.	Yes	RW	3,45-48	225.0	18	40	40	12.8	2100	7-10	4-8	Fertilizer plant
Little Creek Field	21	2	1320	1320	Prom.		FW	3,49-50	101.0	56	30	40	4.0	4500	27	13.0	
Port Neches	30	17	600	450	TETT		RW	3,51	12.5	20	30	40	4.3	3310			Industrial source
Garber	25-30	7-10	70	70	Succ.	No	P	3,52	0.6	30	21	10	1.8	1075	6.3		Fertilizer plant
West Sussex Unit	28	6	14	14	Prom.		P	3,53	0.2	27	22	10	0.8	1550	12.9		McCallum field
Quarantine Bay	38	15	125	125	Prom.	No	P	3,54	1.1	23	15	10	1.4	3480	2.57		New Orleans plant
Rock Creek	33	10	13	13	Succ.	No	P	3,30,55	0.7		31	10	0.8	1000	13	9.0	

Sho-Vel-Tum	59	42	2200	1800	Succ.	Yes	LW	3
Citronelle	63		3300	350	Prom.		FW (Exp.L)	3
Rose City North	50	35	500	500	Prom.		FW	3
Rose City North	50	35	500	500	Prom.		FW	3
Tinsley	65	38	150	150	Prom.	No	FW	3
Hansford Marmaton	43		390	390	Succ.	Yes	FW	3
Oliva	17	2	450	450	Succ.	Yes	FW	3
Paradis	62	48	400	400	Prom.	No	RW	3
Paradis	45	33	100	100	Prom.	No	RW	3
Paradis	45	33	100	100	Prom.	No	RW	3
El Mar	40.3	10	100	100			RW	3
Kane	70	40	35	10	TETT		P	3
Paradis	44	24	325	325	Prom.		P	3

ABBREVIATIONS

Project Maturity

JS: Just started
HF: Half finished
NC: Near completion
C: Completed
PP: Postponed
Term: Terminated

Previous Production

Prim.: Primary
WF: Waterflooding

Project Evaluation

TETT: Too early to tell
Prom.: Promising
Succ.: Successful
Disc.: Discouraging

Project Scope

P: Pilot
FW: Field wide
LW: Lease wide
RW: Reservoir wide
Exp. UL: Expansion unlikely
Exp. L: Expansion likely

Table 2.1.1. Summary of Field and Pilot Applications of the Carbon Dioxide Miscible Displacement in Waterflooded Sandstone Reservoirs (Ref. 3,34-55) (Continued)

Field	Injection Pattern	CO_2 Injected HCPV	Oil Recov. % OOIP	CO_2 Injection Mechanism	Disposition Environment	Comments
Lost Soldier			10.0	WAG		Good areal, poor vertical efficiency
Wertz	5 spot	60	9-10	WAG 1:1 (1.5% ea.)	Eolian deposit	Dykstra Parsons, D.P. = 0.8, good areal efficiency
North Ward Estes	5 spot/line dr.	38	8.0	WAG 1:1 (2.5% ea.)	Tidal flat to lagunal	D.P. = 0.85, OGCap, Kv/Kh = 0.10
Rangely Weber Sand	5 spot	30	2-7	WAG 1:1 + water		Dip = 6/ 15-30 o, OGCap, Kv/Kh = 0.25- 0.50
Ford Geraldine	5 spot	30	13.0	C01 slug + brine	Deep water fan channel	Good vertical & poor areal sweep efficiecy
Twofreds	5 spot/line dr.	40	9.0	Slug + WAG + flue gas	Deep water fan channel	Dystra Parsons = 0.5
Northeast Purdy Unit	5 spot	30	7.5	Slug + WAG 3:1	Shallow marine	Dip = 8 o
Little Creek Field	1/4 of 9 spot			C02 slug		
Port Neches	5 spot		19.0	WAG		
Garber	5 spot	35	14.0	Slug + chase water	Deltaic & shallow marine	Lateral reservoir variation, dip < 5 o
West Sussex Unit	Inv. 4 spot	30	7.8	Slug + chase water		Dip = 6 o
Quarantine Bay		18.9	16.9	WAG 1:1/2:1, 14 cycles	Inner deltaic	Dip = 4 o
Rock Creek	4 & 5 spot	48	11.0	Slug + chase water		OGCap, Kv/Kh = 0.79

- Recovery efficiencies range from 2 to 19 percent of OOIP, and the net amount of CO_2 required to recover an incremental barrel of oil varies from 3 to 13 thousand standard cubic feet (Mscf). The average recovery for documented cases is 10.8 percent of OOIP and the average CO_2 utilization ratio is 7.2 Mscf of carbon dioxide per incremental barrel of oil. These values agree fairly well with ones reported by Martin for application of CO_2 miscible displacement in different types of reservoir rock.[5]

- The most common well spacing is 40 acres per well, even though some applications--especially the pilot tests--had spacing of 10 acres per well. The preferred configuration was the 5-spot, sometimes combined with a line drive. The predominant injection mechanism was a 1:1 water alternating with CO_2, with innovations such as hybrid and tapered injection sometimes used. Injected CO_2 volumes varied between 19 and 60 percent of hydrocarbon pore volume (HCPV), with an average injection rate of 36 percent HCPV.

- Even though it was not possible to find complete information about the depositional environment of the reservoir rock, available data indicate reservoirs of diverse depositional environments, but all with relatively good continuity.

- Reported reservoir dips varied between 4 and 30 degrees, with a clear predominance of reservoirs with a low dip angle. Several of the reservoirs also had initial gas caps.

- The most common problems encountered during a project were surface and downhole equipment corrosion which was reported in 58 percent of the cases reviewed, followed by low vertical efficiency (50 percent of the cases), and asphaltene or paraffin precipitation (30 percent of the cases). It is also evident that the industry has gained a lot of experience dealing with these problems and had found ways to prevent or minimize them.

- Project profitability was not always reported, but about half of the reported cases were profitable. Obtaining CO_2 was usually responsible for a good portion of the project cost. Most of the reported sources of CO_2 were nearby industrial plants, which allowed for relatively easy transportation.

- Using the average estimated carbon dioxide utilization rate and an assumed cost of $0.70 per Mscf, the average recovery cost is about $5 per incremental barrel of oil.

- It is evident that in many of these projects, CO_2 injection rates were adjusted to maximize process efficiency. To do this, it was necessary to have good monitoring and maintenance programs so that the process performance could be assessed during the project life.

- More research is needed into methods for improving vertical sweep efficiency. Efficient vertical sweep requires a knowledge of reservoir geometry, and vertical and lateral geo-continuity and characteristics.

- From the point of view of field operations, many factors can be improved to reduce costs and therefore enhance project economics. These include: the optimized use of existing wells; injecting gels or polymers to improve areal sweep efficiency; injection of fluids at selected vertical intervals in the well bore; reutilization of existing facilities; optimization of pressure build up in the reservoir; CO_2 recycling; and finally, application of technologies like horizontal drilling. Improvement in these factors could significantly increase the volumes of oil recovered and decrease the volume of CO_2 injected, therefore improving project profitability.

2.2 Texaco's Port Neches Field Test

In 1992, DOE and Texaco entered into a cooperative agreement to establish the viability of using miscible CO_2-EOR technology on Fluvial Dominated Deltaic (FDD) reservoirs, a large number of which are located along the Gulf Coast. This work was undertaken, in part, because primary and secondary recovery usually leaves more than 50 percent of the original oil in place behind. Texaco's project demonstrated the viability of the process in the Marginulina reservoir in the Port Neches field, Orange County, Texas. A by-product CO_2 source was used in the project and transported via pipeline from a nearby gas processing plant.

2.2.1 Relevance of the Technical Demonstration

The results of the demonstration project are expected to validate the use of a miscible CO_2 flood in other FDD reservoirs, particularly those reservoirs that have previously been waterflooded or that have a weak waterdrive, and provide a basis on which the decision to use the process in similar reservoirs can be made. Other petroleum operators will be able to predict the amount of incremental oil recovery that can be expected based on the experiences and results gained from this project. The project will demonstrate the impact of reservoir heterogeneities and the importance of reservoir characterization. The project will also provide a basis for estimating the applicability of the technology to highly heterogeneous clastic reservoirs other than FDD reservoirs. The project also demonstrated the effectiveness of a horizontal CO_2 injection well, noting the improvements in sweep efficiency of the residual oil column.

2.2.2 Encouraging Private Sector Implementation

The results in the Port Neches field will enable other oil and gas companies to assess the practicability and appropriateness of using CO_2-EOR in other reservoirs of this category. This technology is expected to have widespread applicability among other FDD reservoirs because it is common for these reservoirs to have relatively weak primary drive mechanisms and high remaining oil saturations after secondary recovery techniques, such as waterflooding, have been applied. Factors that could affect a company's decision to use this technology may include:

1. The incremental oil recovery expected by applying this process.

2. The availability and cost of CO_2, including transportation costs.

3. The costs of facilities, well workovers, drilling additional injection and/or producing wells, and incremental operating costs associated with the project.

4. The CO_2 recycle compression cost.

5. The overall project economics.

Based on the degree of success and profitability of the project, other petroleum operators that have similar reservoirs will be able to make intelligent decisions concerning the merit of using the CO_2-EOR.

3.0 Texas Reservoir Database

Appendix A provides a full description of the data elements in the Texas Reservoir Database developed for this project. Much of the information contained in the data base was derived from the hearings files of the Texas Railroad Commission. Commission data that proved particularly informative include unitization, injection, maximum efficient recovery, field rules, and date of discovery files. Additional sources of numerical and descriptive data include:

1. Oil and gas reservoir files compiled by the U.S. Department of Energy, Energy Information Agency, Dallas Field Office.

2. Compilations of field studies published by various regional geological societies, the American Association of Petroleum Geologists, and the Society of Petroleum Engineers.

3. Publications of the Texas Railroad Commission, including the 1981 Annual Report and a survey of secondary and enhanced recovery operations.

4. Publications by the Rand Corporation and the U.S. Department of Energy on major oil and gas fields in the United States and evaluations of fields targeted for enhanced recovery.

Data were supplemented with information provided by individual operating companies. All of the above sources are documented in the Bibliography at the end of this report.

The accuracy of publicly available quantitative reservoir data varies greatly. Different sources commonly gave different values for the same type of data. Where great discrepancies exist, data values were selected on the basis of known geologic criteria and within the context of the overall information available on a reservoir. Data were weighted in favor of records that reflected greater geological and engineering research efforts.

4.0 Screening Criteria

This section provides a description of the technical criteria used for the technical screen performed on the Texas Reservoir Database. It is followed by a section outlining the calculation of the cost of obtaining CO_2 and its likely sources. The economic screen is then described and assumptions and limitations of the study are discussed. Finally, the results of the technical and economic screen are presented.

4.1 Technical Criteria (Calculation of Technical Ranking Factor)

The Rivas study defined the optimum reservoir characteristics by performing numerical simulation on a base case to determine the value of a selected set of parameters which maximized oil recovery from the simulated CO_2 flood. The base case was assumed to be a 10-year injection program in a five-spot well configuration with 40 acre spacing. The optimum values for the parameters were determined by varying parameter values slightly around starting-values provided by Rivas. Few, if any, reservoirs would exactly match the parameter values of this ideal. The numerical simulation was performed using three off the shelf reservoir simulation models -- a fully compositional simulator, a black oil model, and a semi-analytical predictive model.

In ranking a set of randomly selected oil reservoirs, Rivas determined reservoir parameter values that represent the most extreme, but realistic departures from the optimum. These extreme parameters are combined to define the worst case reservoir. This worst case reservoir, in most cases, would not be one of the actual reservoirs being ranked, but rather would be a hypothetical reservoir and provides a boundary for parameter values. Reservoirs with parameter values which are "outside" the worst case were either eliminated from the analysis or their outlier parameters were assigned the worst case value.

As parameters were varied around their optimum, Rivas noted their effect on the variation in oil recovery. The shape of parameter performance curves suggested that some of the parameters may have more of an effect on performance than others. Parameters that produced a more acute effect on production were considered to be more important than those that have little effect. Rivas assigned weights to the parameters based on their relative effect on production. The most influential parameters were found to be API gravity, oil saturation, and reservoir pressure.

Table 4.1.1 presents the parameters which optimized process performance as given by the numerical simulations discussed above. It also provides the upper limit on the value of a parameter and shows the weight assigned by Rivas based on the relative influence of each parameter on production. Results from the three simulations for the most influential parameters are shown in Figures 4.1.1, 4.1.2, and 4.1.3 taken from Rivas.

Rivas assigned one technical ranking factor for each reservoir by calculating the weighted sum of all the reservoir property parameters. The technical ranking factor was then normalized so that the best reservoir has a factor of 100, and the worst reservoir has a factor of 0.

Table 4.1.1. Optimum Reservoir Parameters, Upper Limit, and Weighting Factors.[22]

Parameter	Optimum	Upper Limit	Weight
API Gravity, °API	37	54	0.24
Oil Saturation, %	60	83.1	0.20
Pressure/MMP	1.3	1.3	0.19
Temperature, °F	160	250	0.14
Net Oil Column, ft	50	300	0.11
Permeability, md	300	2500	0.07
Dip, degrees	20	20	0.03
Porosity, %	20	35	0.02

Source: Rivas, O., Embid, S., and Boliver, F. "Ranking Reservoirs for CO_2 Flooding Processes," SPE paper 23641 presented at the 1992 SPE Latin American Petroleum Engineering Conference, Caracas, March 8-11.

This method of ranking reservoirs was used to rank the reservoirs in the Texas Reservoir Database. Several reservoirs were first eliminated from the database because important data, e.g. API gravity, were either missing or questionable. The remaining reservoirs were then ranked using the technical screen procedure described above. Then, the economic screen was applied as described in Section 4.3. The economic screen is heavily dependent on sources and costs of obtaining CO_2 which are described in the next section (4.2).

Figure 4.1.1 Average Oil Production as a Percent of Oil Saturation

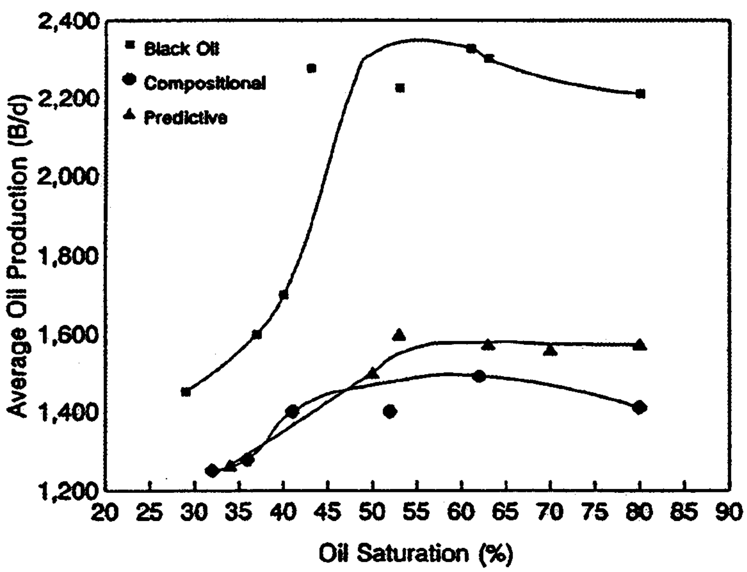


Figure 4.1.2 Average Oil Production as a Function of Pressure Ratio

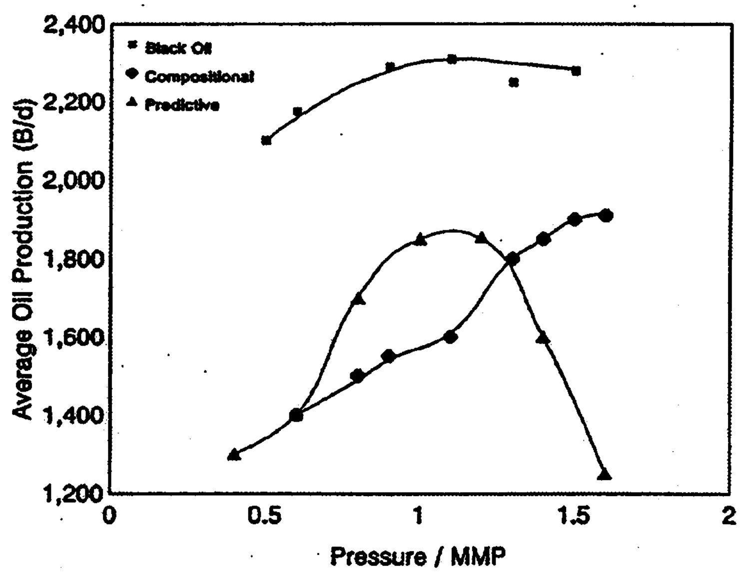
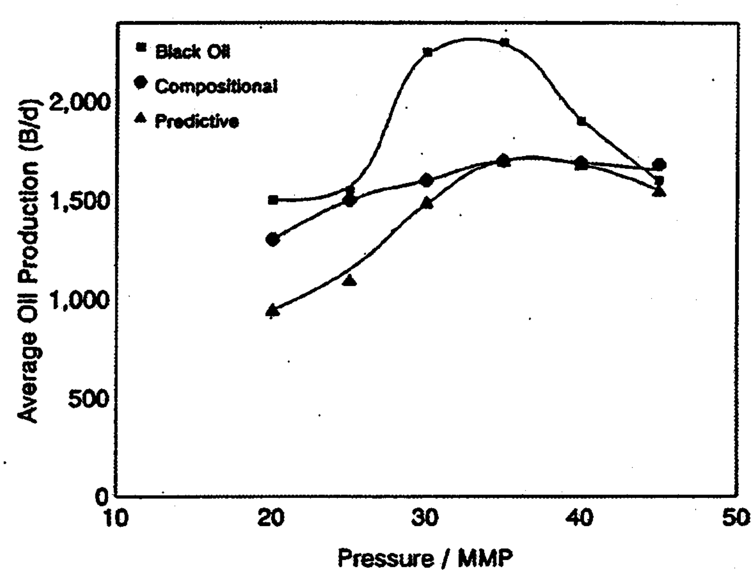


Figure 4.1.3 Average Oil Production as a Function of API Gravity



4.2 Sources of Carbon Dioxide and Cost

Sources of CO_2 were derived primarily from studies performed by Science Applications International Corporation (SAIC) for the Department of Energy, Morgantown Energy Technology Center (METC)[6]. It was assumed that only Permian Basin CO_2 demand would be supplied by naturally occurring CO_2. All other promising reservoirs, particularly those in the Gulf Coast region, have access to highly pure CO_2 produced as a by-product of local industry and natural gas processing plants (Figure 4.2.1).

Miscible CO_2-EOR technology has a history of success in the vast West Texas oil fields. However, recent efforts by Texaco, Shell, and others to emulate the West Texas successes on the Gulf Coast have so far proved inconclusive. There are three reasons for the inconclusive results:

1. There are significant differences between the reservoirs in West Texas and those along the Gulf Coast. West Texas CO_2-EOR projects are located primarily in carbonate reservoirs with limited faulting, whereas Gulf Coast reservoirs tend to be primarily clastic and highly faulted;

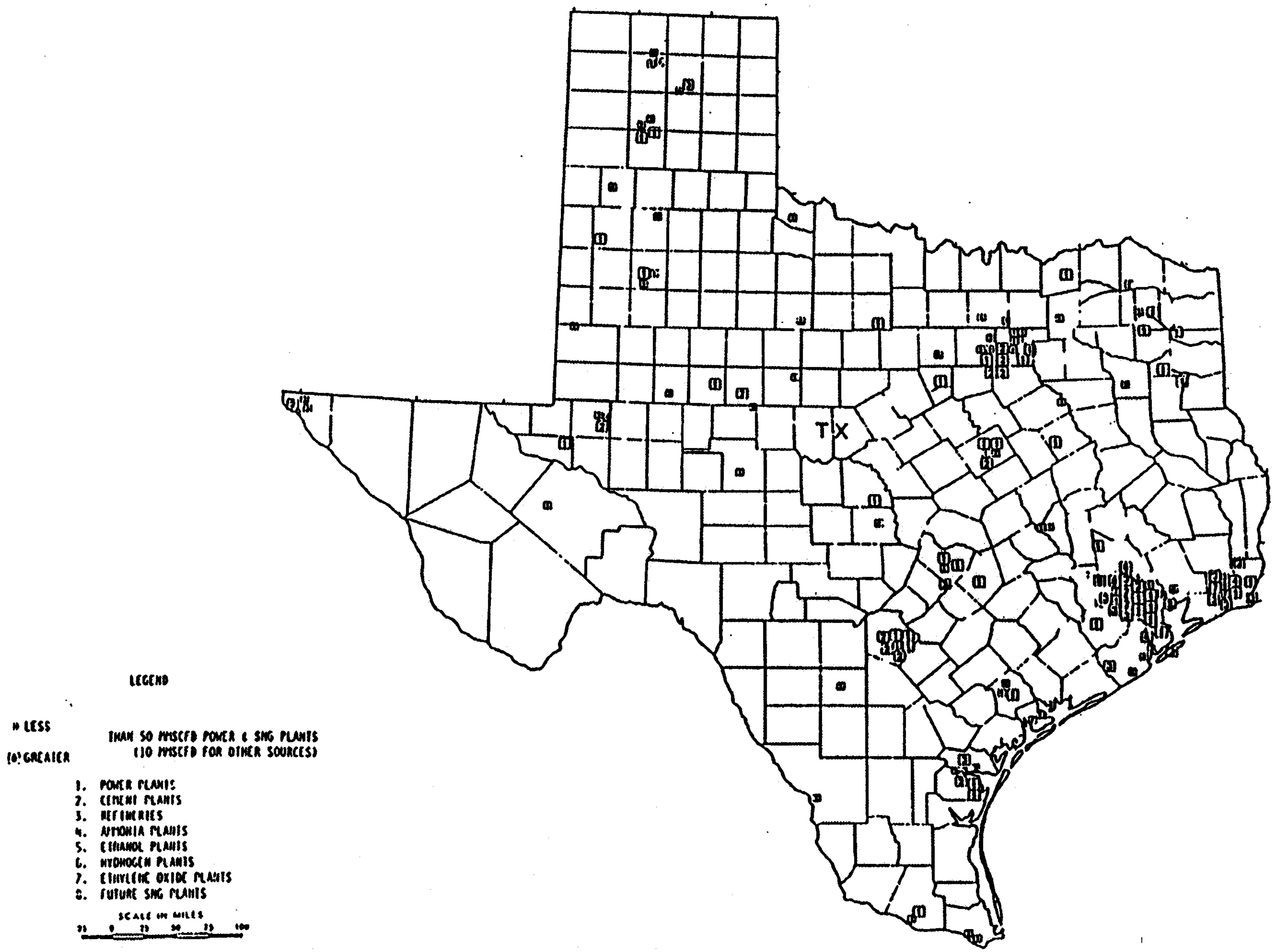
2. A plentiful CO_2 source and transportation network brings CO_2 to the West Texas fields, whereas the Gulf Coast lacks such a network; and

3. The contrast in the surface environment affects transportation, emission containment, and water disposal options and costs. These effects are shown in Table 4.2.1

Table 4.2.1 Comparative Features Affecting CO_2-EOR Design

	West Texas Features	Gulf Coast Features	Net Effect on Gulf Coast CO_2-EOR
Reservoir Type	Carbonate reservoirs with limited faulting.	Clastic and highly faulted.	Poor pattern design, limited success in forecasting oil recovery, CO_2 channeling, and higher recycle costs.
CO_2 Source	Large number of developed natural supply sources and integrated network.	One natural supply, a number of smaller by-product supplies, limited pipeline network.	May require developing the CO_2 source and building a pipeline network.
Surface Features	Minimally populated prairies with low annual rainfall.	Wetlands, timber-lands, and farm-land intermixed with high density areas with considerable rain-fall.	Pipelines more expensive in sensitive areas, water disposal requires consideration, air pollution may be a factor.

Figure 4.2.1. By-Product Sources of Carbon Dioxide in Texas



Impurities, such as nitrogen (N_2) hydrogen sulfide (H_2S), or methane (CH_4) are common in natural sources of CO_2, while nitrogen and carbon monoxide (CO) are common in manmade sources, such as flue gas. The presence of these impurities produces variations in CO_2 miscibility pressure and creates safety and production problems. Contamination by N_2, CO, and CH increases miscibility pressure and therefore requires higher operating pressures. Although contamination by H_2S decreases miscibility pressure, this positive effect is more than offset by the additional fail-safe metering and more expensive and corrosion resistant higher carbon steel required to manage the H_2S. Project economics are substantially improved when a source of CO_2 with greater than 95 percent purity is used.

The pressure of CO_2 at its source is a critical factor in CO_2 transportation and injection costs. At pressures above 1,000 psi, CO_2 is a liquid and can be transported relatively cheaply using pumps or a natural pressure drop. Either option is cheaper than the alternative method of purchasing and operating gas compressors. In addition, to get CO_2 to the reservoir at a pressure above miscibility pressure generally requires injecting CO_2 above 1,000 psi. Raising the pressure from atmospheric pressure to 1,000 psi can cost $0.10 to $0.25 per Mscf, depending on capital equipment and energy costs.

The only industrial by-product sources that can potentially provide CO_2 for a delivered cost less than $2 per Mscf are power plants and highly pure sources from ammonia plants and catalytic cracking units. Sources of CO_2 in Texas, by county, are listed in Tables 4.2.2, 4.2.3, and 4.2.4. It is assumed that by-product sources of CO_2 will on average cost more than natural sources. Because CO_2 is a unique input variable, a miscible CO_2-EOR project which relies on an industrial by-product source is penalized with a 20 percent cost premium.

Pipelines are the most economical form of transport for large volumes of CO_2 over short and long distances (one to 20 miles and more than 150 miles). Truck transport is competitive with pipelines for small volumes (one to 10 MMscf per day) over medium distances. For pilot projects, either truck or rail may be the best method of transport, depending on the availability of transport system equipment, rail facilities, and the volumes of CO_2 required.

Table 4.2.2 Power Plants by County

County	Company, Plant, Unit	Capacity MW	Type of Fuel Coal © Oil (O) Gas (G)	Approx. CO_2 MMSCF/D	CO_2 Quality (% Vol)					
					CO_2	O_2	N_2	No_x	SO_2	N_2O
Houston Lighting & Power										
Fort Bend	Parish Unit 6	660	C	167	13.6	2.3	71.8	.39	.069	11.9
	Unit 7	600	C	152	13.6	2.3	71.8	.39	.069	11.9
	Unit 8	600	C	152	13.6	2.3	71.8	.39	.069	11.9
	Limestone Unit 1	750	C	190	13.6	2.3	71.8	.39	.069	11.9
	Unit 8	750	C	190	13.6	2.3	71.8	.39	.069	11.9
Texas Power & Light										
Rusk	Merlin Lake Unit 3	750	C	190	13.5	1.9	71.4	.42	.26	12.5
	Sandow	545	C	138	13.5	1.9	71.4	.42	.26	12.5
	Forest Grove Unit 1	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Twin Oak Unit 1	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Unit 2	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Unsiled Unit 1	750	C	189	13.5	1.9	71.4	.42	.26	12.5
	Unit 2	750	C	189	13.5	1.9	71.4	.41	.26	12.5
	Unit 3	750	C	189	13.5	1.9	71.4	.41	.26	12.5
Lower Colorado River Authority										
Baylor	Seymour Unit 1	550	C	140	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	550	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 3	400	C	101	13.5	1.9	71.4	.41	.26	12.5
Southwestern Public Service										
	Celanese Unit 2	29	C	8	13.5	1.9	71.4	.41	.26	12.5

Table 4.2.2 Power Plants by County (Continued)

County	Company, Plant, Unit	Capacity MW	Type of Fuel Coal © Oil (O) Gas (G)	Approx. CO_2 MMSCF//D	CO_2 Quality (% Vol)					
					CO_2	O_2	N_2	NO_x	SO_2	H_2O
Brazos Electric Power Coop										
	San Miguel Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	400	C	101	13.5	1.9	71.4	.41	.26	12.5
Texas Power Pool										
	Gibbons Creek Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unsited Unit 1	400	C	101	13.5	1.9	71.4	.41	.26	12.5
	Unit 2	400	C	101	13.5	1.9	71.4	.41	.26	12.5
San Antonio Public Serv. Brd.										
	Unsited Unit 1	500	C	127	13.5	2.3	71.8	.39	.069	11.9
Harris	Wharton	322	C	56.5	9.1	1.7	72.1	-	-	17.0
Lower Colorado River Auth.										
Llano	Ferguson		C	45.9	9.1	1.7	72.1	-	-	17.0
Harris	Clarke	210	G	15.3	9.1	1.7	72.1	-	-	17.0
Harris	Clarke	210	G	15.3	9.1	1.7	72.1	-	-	17.0
Harris	Deepwater	353	G	45.9	9.1	1.7	72.1	-	-	17.0
Harris	Green Bayou	821	G	115.3	9.1	1.7	72.1	-	-	17.0
Fort Bend	Parish	2723	G	347.2 0.0 89.6	9.1	1.7	72.1	-	-	17.0
Galveston	Robinson	2314	G	432.0	9.1	1.7	72.1	-	-	17.0
Harris .	Webster	614	G	96.5	9.1	1.7	72.1	-	-	17.0

Table 4.2.4 List of Fluid Catalytic Cracking Units CO_2 Generation Capacity

County/City	Company	Capacity MBBLS/ Stream Day	CO_2 Generated MMSCF/D
Brazoria/Sweeney	Phillips Petroleum Co	42.2	8.7
Ector/Odessa	Shell Oil Co.	16.0	3.3
El Paso/El Paso	Chevron USA, Inc.	28.6	5.9
El Paso/El Paso	Texaco, Inc.	9.1	1.9
Galveston/Texas City	Amoco Oil Co.	217.0	44.5
Galveston/Texas City	Marathon Oil Co.	39.0	8.0
Galveston/Texas City	Texas City Refining Inc.	40.0	8.2
Harris/Baytown	Exxon Co. USA	185.0	37.9
Harris/Deer Park	Shell Oil Co.	91.0	10.7
Harris/Houston	Atlantic Richfield	83.0	17.5
Harris/Houston	Charter International Co.	62.4	10.0
Harris/Houston	Crown Central Petroleum Corp.	50.0	10.0
Howard/Borger	Phillips Petroleum Co.	62.4	12.0
Jefferson/Beaumont	Mobil Oil Corp.	123.0	25.0
Jefferson/Beaumont	Union Oil Co. Of California	42.0	8.0
Jefferson/Port Arthur	American Petro-Inc.	36.0	7.4
Jefferson/Port Arthur	Gulf Oil Co.	126.0	25.8
Jefferson/Port Arthur	Texaco, Inc.	175.5	36.0
Moore/Sunray	Diamond Shamrock Corp.	32.5	6.7
Nueces/Corpus Christi	Champlin Petroleum Co.	89.7	18.4
Nueces/Corpus Christi	Coastal States Petrochemical Co.	10.6	2.2
Nueces/Corpus Christi	Southwestern Refining Cl.	12.7	2.6
Nueces/Corpus Christi	Sun Cl.	31.5	6.5
Potter & Randall/Amarillo	Texaco, Inc.	10.4	2.1
Smith/Tyler	La Gloria Oil & Gas Co.	10.5	2.2
Tarrant/Fort Worth	Winston Refining Co.	6.0	1.2
Titus/Mt. Pleasant	Dorchester Refining Co.	12.0	2.5

4.3 Economic Screening Criteria

The economic screen is a simple discounted cash flow comparison of most of the reservoirs remaining after the technical screening. Economic screening and prioritization are based on the ratio of net revenue (profit) to cost. It was assumed, for the purpose of economic ranking that the technical ranking factor calculated with the technical screen provides a reasonable approximation of a potential oil recovery factor.

The potential oil recovery used in the economic screen is defined as the product of the original oil-in-place, the expected recovery factor for CO_2 flooding, and the technical ranking factor. Other parameters used in the economic screen are reservoir area, number of existing wells, depth, and distance to a CO_2 source. All capital and operating costs are calculated using equations shown in Table 4.3.1. Major assumptions for the screen are CO_2 price, oil price, well spacing, and expected recovery (fraction of OOIP).

Table 4.3.1 Economic Calculation Equations

Parameter	Definition
Gross Revenue	Gross Revenue = Recoverable oil * oil price. where, Recoverable oil = OOIP * Technical ranking factor * Recovery factor.

Capital cost
o Drilling(7,8)
o Equipment(9)
o CO_2 Pipeline(10,11)
 	
o Separation(12,13)
	
	New well cost = \$30,340 * # wells * $e^{(0.00035 * depth)}$
	Equipment = 8.3125 * depth * # wells
	Pipeline = [\$100,000 + (pipeline capacity$^{0.834}$)] * distance
	where,
	pipeline capacity = 6 * (Recoverable oil)
	
	Separation = Recoverable oil * 4 (Mscf/B) * \$0.25

Operating Costs	Well Operations = (1,040 + 0.1462 * depth) * 12 * # wells
CO_2 Cost(14,15,16)	CO_2 Costs = Recoverable oil * 6 (Mscf/B) * price (\$/B)
Net Revenue	Net Revenue = (Gross Revenue - Total costs) * (1.0 - tax rate)
Profit/Cost Ratio	Profit/Costs = Net revenue/ Total Costs

Source: Equation sources are in parentheses and were extracted from papers listed in the references.

4.4 Assumptions and Limitations of the Screening

In order to rank the reservoirs, it is necessary to have a parameter that can be easily used for comparison of all of the possible reservoirs. Several assumptions based on engineering judgement supported by data and literature review, were made to maintain the manageability of the analysis.

- The maximum expected recovery from the miscible CO_2-EOR process is 10 percent of original oil in place. The review of the field and pilot applications suggests that this value is technically sound, if not on the conservative side. In this assumption, the kind of processes used for the displacement are not differentiated, and the same annual production profile is used for all reservoirs used in the discounted cash flow.

- The reservoirs possessing better properties for the process are assumed to perform better economically. The technical ranking factor obtained from the technical screening is used to determine the potential recovery factor (PR) that is used to predict reservoir performance.

- Parameter values used in the equations are from published investigations. If any of the parameter values are biased, they are applied to all reservoirs equally and should therefore not introduce bias to any specific reservoir.

- Dip was unknown in most cases and in fact is probably not constant for the largest reservoirs. The reservoirs for which dip was known averaged about 10 degrees, albeit with some extreme variation. For this analysis the dip was set at a constant 20 degrees for all reservoirs.

- Well spacing was assumed to be uniform and constant. Although the areal extent of each reservoir was generally not known, for the screen each reservoir was normalized to equal one five spot on a 40-acre spacing. It was further assumed that all five wells were already equipped and operational. The original oil in place in this normalized reservoir is calculated as the product of net pay, porosity, and oil saturation. Most reservoirs in this study are many times larger than this assumption and most wells would probably not be fully developed or would need to be drilled.

- Operating costs and CO_2 costs are reported on an annual basis and are assumed to be constant over the life of a project. The expected life of a project is assumed to be twenty years.

- The cost of using CO_2 from non-natural sources is assumed to be 20 percent more expensive than using naturally occurring CO_2.

4.5 Results of Technical and Economic Screening

The screening methods described above were used to screen the largest, most productive reservoirs in the State of Texas. Initially the database contained over 500 reservoirs. Over 100 reservoirs were initially eliminated due to a lack of geologic information, leaving 378 reservoirs with sufficient data for the technical screen.

Table 4.5.1 presents the ranking of the 211 reservoirs left after the economic screen was performed. There are two columns with rank numbers. The first column shows the results of the technical screen. The second column shows the result of the economic screen, ranked in order. The economic parameters used in the screen were: recovery factor - 10 percent; oil price - $17/bbl; taxes - 15 percent; CO_2 costs - $0.60 per Mscf.

The screens provide a very fast method of ranking many reservoirs, making sensitivity analysis on key parameters practical. The economic ranking, although simple, appeared to give valid results as most of the current CO_2 field applications that were contained in the database placed high in the rankings. That is, the projects that ranked high after the survey are already considered profitable by their operators.

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
KEYSTONE COLBY	38	87	3	54.87	0.95	13	900	10	99.70	200	5	3100	72.89	2.536
VAN WOODBINE	34	140	1000	75.66	0.36	29	250	10	85.18	200	5	2700	44.94	2.428
HASTINGS, W. FRIO	31	160	865	66.51	0.59	31	163	10	52.19	200	5	6100	57.64	2.244
ESPERSON DOME S. CROCKETT	39	200	240	63.18	0.9	27	176	10	46.63	200	5	7300	77.97	2.179
FAIRBANKS FAIRBANKS	36	185	2000	58.2	0.73	28	91	10	23.03	200	5	6800	81.68	2.036
WASSON	33	107	4	66.51	0.67	10	275	10	28.41	200	5	4900	55.35	1.993
HOWARD-GLASSCOCK PERM.	32	86	25	58.2	0.2	12	147	10	15.94	200	5	1500	56.91	1.990
SUGARLAND UPPER FRIO	29	149	900	59.86	0.33	29	85	10	22.91	200	5	3800	58.45	1.930
OYSTER BAYOU SEABREEZE	36	190	1325	66.51	0.89	29	150	10	44.93	200	5	8300	75.20	1.920
LIVINGSTON WILCOX	35	183	70	62.35	0.65	21	81	10	16.47	200	5	7400	78.44	1.787
SEMINOLE WEST	34	102	9	68.17	0.82	10	180	10	19.06	200	5	5100	59.28	1.774
LAKE PASTURE H-440 S	24	155	1197	56.53	0.32	32	75	10	21.07	200	5	4500	45.29	1.696
COWDEN NORTH	35	114	7	63.27	0.68	10	125	10	12.28	200	5	4300	71.33	1.675
WELLMAN	43	151	100	64.02	1.88	8	338	10	26.88	200	5	9300	73.34	1.633
WALNUT BEND REGULAR	36	115	176	62.35	0.94	19	50	10	9.2	200	5	4900	83.53	1.591
GOOD	44	140	52	53.21	1.94	8	246	10	16.26	200	5	8000	64.17	1.588
WADDELL	34	88	12	53.21	0.78	11	100	10	9.09	200	5	3500	65.57	1.499
UNIV. BLOCK 31 DEVONIAN	40	140	0.7	49.88	1.69	15	130	10	15.11	200	5	8500	75.70	1.484
SEMINOLE	35	108	25	73.33	0.81	13	87	10	12.88	200	5	5200	55.25	1.458
HAWKINS WOODBINE	24	168	3394	74.82	0.25	26	109	10	32.93	200	5	4500	21.30	1.449
TODD DEEP CRINOIDAL	41	163	14	67.34	1.01	12	115	10	14.43	200	5	5800	73.71	1.417
TODD DEEP ELL.	42	158	5	54.87	1.09	7	155	10	9.25	200	5	6000	76.58	1.390
WASSON 6600 AND 7200	33	118	10	63.18	0.71	8	135	10	10.6	200	5	6900	66.87	1.322
GOLDSMITH CLEAR FORK	40	110	5	62.35	1.37	12	70	10	8.13	200	5	6100	84.35	1.304
GOLDSMITH 5600	38	105	25	58.2	1.14	15	50	10	6.78	200	5	5600	87.58	1.262
ANAHUAC MAIN FRIO	35	178	1085	54.04	0.76	28	66	10	15.51	200	5	7100	78.03	1.241
YATES PERM. GUAD.	30	82	118	62.35	0.29	10	120	10	11.62	200	5	1250	50.13	1.228
WARD-ESTES NORTH	38	81	40	54.04	0.91	20	30	10	5.04	200	5	2500	72.68	1.198
TOM O'CONNOR 5900	35	176	2136	71.5	0.63	32	30	10	10.66	200	5	5900	58.55	1.178
GARZA	35	90	8	43.23	0.49	21	55	10	7.75	200	5	2500	47.02	1.139
VEALMOOR EAST	48	155	38	69.84	2.2	10	107	10	11.6	200	5	7400	49.80	1.138
EMPEROR DEEP	33	80	20	48.22	0.67	17	61	10	7.77	200	5	2900	51.17	1.120
GILLOCK, S. BIG GAS	38	154.8	900	64.02	1.41	28	36	10	10.02	200	5	9600	93.41	1.118
FALLS CITY LBAR., LPA.	39	190	371	62.35	0.73	30	25	10	7.26	200	5	6100	76.38	1.116
HELEN GOHLKE WILCOX	34	240	180	58.2	0.59	20	47	10	8.5	200	5	8100	69.74	1.109
PLYMOUTH HEEP	31	162	3300	66.51	0.52	28	28	10	8.1	200	5	5600	55.76	1.107

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
MIDLAND FARMS	32	102	61	66.51	0.72	14	100	10	14.46	200	5	4800	56.80	1.093
GLASCO DEVONIAN	37	186	200	58.2	1.39	14	67	10	8.48	200	5	12600	95.70	1.091
WEST RANCH 41-A	32	171	869	59.86	0.55	30	35	10	9.76	200	5	5700	70.21	1.081
FUHRMAN-MASCHO	32	95	5	54.04	0.71	13	72	10	7.86	200	5	4300	59.70	1.078
WHITE POINT E. BRIGHTON	39	162	575	51.55	0.83	33	26	10	6.87	200	5	5700	73.64	1.074
SLICK WILCOX	36	218	350	62.35	0.68	22	50	10	10.65	200	5	7300	76.46	1.044
WALNUT BEND HUDSPETH	40	110	138	50.71	0.99	20	40	10	6.3	200	5	3900	67.97	1.042
CONROE MAIN CONROE	38	170	1400	64.02	0.64	32	65	10	20.68	200	5	5200	79.68	1.037
WELCH	33	96	9	63.18	0.86	10	100	10	9.81	200	5	4900	69.92	1.036
EMBAR ELLENBURGER	45	115	40	62.35	2.32	5	195	10	9.44	200	5	7700	62.44	1.023
TOM O'CONNOR 5500	31	169	816	58.2	0.51	31	26	10	7.28	200	5	5500	63.98	1.007
VEALMOOR	46	164	32	57.37	1.83	10	95	10	8.46	200	5	7800	69.94	0.991
HAMLIN EAST	39	117	350	64.85	0.65	19	25	10	4.78	200	5	3200	67.70	0.987
EAST TEXAS WOODBINE	38	146	1300	71.5	0.56	25	35	10	9.72	200	5	3600	60.38	0.974
THOMPSON FRIO	25	168	1100	58.2	0.37	30	40	10	10.85	200	5	5400	47.80	0.966
SALT CREEK	40	129	10	59.03	1.31	12	100	10	11	200	5	6300	87.97	0.942
SAND HILLS MCKNIGHT	33	86	1	49.88	0.73	9	150	10	10.46	200	5	3500	52.91	0.928
CHOCOLATE BAYOU ALIBEL	42	225	400	58.2	1.27	29	26	10	6.81	200	5	9400	75.05	0.913
HALLEY	34	83	20	58.2	0.67	16	45	10	6.51	200	5	2700	70.33	0.904
CORDONA LAKE DEV.	40	103	15	49.88	1.49	18	60	10	8.37	200	5	5400	71.45	0.889
ADAIR WOLFCAMP	43	133	28	63.18	1.84	12	68	10	8.01	200	5	8500	76.25	0.883
TAYLOR-LINK	32	84	40	66.51	0.26	15	35	10	5.42	200	5	1300	49.73	0.877
SCARBOROUGH	37	85	12	49.88	1.07	17	55	10	7.24	200	5	3000	72.56	0.863
AMACKER-TIPPETT ELL.	53	201	23	70.67	4.28	6	285	10	18.77	200	5	12100	33.68	0.853
THOMPSON, S. 5400	25	155	900	59.03	0.42	31	29	10	8.24	200	5	5300	46.89	0.842
DARST CREEK EDWARDS	36	98.8	200	49.88	0.56	21	150	10	24.4	200	5	2600	57.93	0.841
HARDIN FRAZIER	38	141.2	500	62.35	1.21	24	26	10	6.04	200	5	7900	91.90	0.831
REINECKE	46	139	22	65.68	1.97	10	65	10	6.63	200	5	6800	62.39	0.827
HULL-SILK-SIKES 3800	39	108.4	180	62.35	0.83	17	26	10	4.28	200	5	3800	74.33	0.822
GATEWOOD	33	90.8	148	62.35	0.3	23	20	10	4.45	200	5	1600	58.88	0.814
SANDUSKY OIL CREEK	42	142	238	61.52	1.11	17	33	10	5.36	200	5	7200	80.78	0.814
DURKEE FAIRBANKS	35	191	2400	63.18	0.68	34	25	10	8.34	200	5	7100	72.99	0.806
FIG RIDGE SEABREEZE	35	198	750	52.38	0.81	27	34	10	7.47	200	5	8500	71.02	0.805
SHAFTER LAKE DEV.	38	135	6	64.02	1.53	5	140	10	6.96	200	5	9500	88.55	0.797
MANVEL F.B. II OLIG.	28	165	500	68.17	0.46	28	48	10	14.23	200	5	5700	45.10	0.785
OLD OCEAN CHENAULT	36	232	640	63.18	0.61	27	60	10	15.9	200	5	9600	72.90	0.782

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
THOMPSON, S. 4400	25	135	367	60.69	0.38	34	35	10	11.22	200	5	4400	44.88	0.778
UNION	33	110	2	70.67	0.98	11	55	10	6.64	200	5	6900	59.91	0.775
HARPER	36	92	2	54.04	0.79	10	50	10	4.2	200	5	4100	72.19	0.768
COWDEN S. 8790 CANYON	40	147	4	60.69	1.53	8	65	10	4.9	200	5	8800	92.41	0.767
MANVEL F.B. I OLIG.	28	165	500	68.17	0.42	28	48	10	14.23	200	5	5100	44.75	0.754
BRANTLEY JACKSON SMACK.	40	205	25	73.99	1.18	22	50	10	12.64	200	5	9200	63.20	0.748
TXL ELLENBURGER	44	138	39	70.67	2.2	4	240	10	10.54	200	5	9600	53.25	0.746
H-J STRAWN	42	122	100	59.86	1.22	9	50	10	4.18	200	5	5500	80.16	0.741
GANADO WEST 4700	24	146	1411	51.55	0.37	33	44	10	11.62	200	5	4700	35.79	0.735
CROSSETT DEV.	44	106	6	54.04	1.8	22	88	10	16.25	200	5	5400	64.14	0.730
GOLDSMITH	36	95	12	68.17	0.83	11	48	10	5.59	200	5	4100	66.72	0.728
PORTILLA 7400	40	206	1634	60.69	0.9	28	28	10	7.39	200	5	7400	76.23	0.726
HENDRICK	28	83	7	49.88	0.52	8	100	10	6.2	200	5	2500	33.21	0.715
RILEY N. U. CLFK.	32	107	12	55.7	0.99	8	70	10	4.84	200	5	6300	70.84	0.695
GOVT. WELLS, NORTH G.W.	21	114	800	58.2	0.17	32	20	10	5.78	200	5	2200	33.15	0.677
VON ROEDER AND N.V.R	43	134	13	66.51	1.57	10	45	10	4.65	200	5	6800	69.96	0.677
DOLLARHIDE CLEAR FORK	38	120	10	62.35	1.35	15	40	10	5.81	200	5	6500	89.41	0.676
TALCO PALUXY	22	147	2000	73.99	0.3	26	44	10	13.14	200	5	4300	20.78	0.675
SEELIGSON ZONE 19-C-4	43	125.2	585	64.02	1.56	24	25	10	5.97	200	5	5900	70.97	0.671
FAIRWAY JAMES LIME	48	260	18	60.69	1.97	11	70	10	7.26	200	5	10000	57.56	0.658
SIVELLS BEND	42	127	126	49.05	1.54	18	46	10	6.31	200	5	6600	66.26	0.657
SHARON RIDGE 2400	32	96	8	54.04	0.14	15	95	10	11.96	200	5	2400	53.78	0.652
LEVELLAND	30	105	2	61.52	0.54	11	50	10	5.26	200	5	4900	55.22	0.643
WORTHAM WOODBINE	39	101.2	1620	83.14	0.76	22	24	10	6.82	200	5	2900	44.26	0.642
GERALDINE-FORD	41	100	49	45.73	0.89	22	28	10	4.37	200	5	2600	49.64	0.626
KEYSTONE SIL.	39	120	3	74.82	1.52	6	113	10	7.88	200	5	8400	64.29	0.623
LIVINGSTON YEGUA	40	154	120	83.14	0.69	28	15	10	5.42	200	5	4500	47.40	0.622
BIG MINERAL CRK. BARNES	37	118	59	56.53	1.01	18	54	10	8.53	200	5	5300	85.19	0.622
COKE PALUXY	27	190	1175	59.86	0.4	22	50	10	10.23	200	5	6300	50.21	0.613
FORT STOCKTON	32	83	35	46.56	0.64	17	38	10	4.67	200	5	2800	43.15	0.600
GOLDSMITH DEVONIAN	40	135	47	62.35	1.37	15	45	10	6.54	200	5	8000	88.82	0.577
SALT FLAT AUSTIN CHALK	36	97.2	0.1	49.88	0.48	18	120	10	16.73	200	5	2400	57.23	0.571
LAWSON	37	94	6	57.45	0.9	10	36	10	3.21	200	5	4300	78.94	0.566
EDWARDS WEST CANYON	41	140	5	62.35	1.72	10	80	10	7.75	200	5	8700	86.33	0.562
FOSTER	35	95	7	62.35	0.8	10	110	10	10.65	200	5	4300	74.36	0.560
BRECKENRIDGE POOL	38	110	15	60.69	0.71	13	35	10	4.29	200	5	3100	75.32	0.557

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
TOMBALL SCHULTZ SE	40	182	1200	62.35	0.77	32	11	10	3.41	200	5	5500	74.29	0.554
SULPHUR BLUFF PALUXY	21	114	4000	49.88	0.38	25	60	10	11.62	200	5	4500	24.08	0.550
GILLOCK BIG GAS	38	214	1470	70.67	1	28	25	10	7.68	200	5	8400	64.33	0.548
UNIV. BLOCK 9 WOLFCAMP	38	140	14	60.69	1.26	10	40	10	3.77	200	5	8400	94.56	0.546
EMMA ELLENBURGER	49	185	54	66.51	3.16	3	290	10	8.99	200	5	12300	48.89	0.545
HULLDALE PENN. REEF	40	156	43	59.86	0.82	9	39	10	3.26	200	5	5800	82.42	0.534
TOM O'CONNOR 4500 GRETA	24	162	2290	56.53	0.29	33	20	10	5.79	200	5	4500	40.74	0.524
KELSEY M-2	47	160	454	60.69	1.31	25	16	10	3.77	200	5	4700	65.87	0.511
RINCON VICKSBURG SAND	44	140	284	64.02	1.36	22	50	10	10.94	200	5	5300	73.95	0.509
SUSAN PEAK	37	139	40	66.51	0.66	10	43	10	4.44	200	5	4700	72.88	0.508
FLUVANNA STRAWN	40	140	93	60.69	1.27	10	42	10	3.96	200	5	7800	90.70	0.507
COWDEN NORTH DEEP	37	107	7	66.51	0.98	8	40	10	3.31	200	5	5100	75.26	0.506
REEVES	32	113	3	53.21	0.65	12	45	10	4.46	200	5	5600	58.35	0.503
SNYDER	30	97	1	62.35	0.37	10	50	10	4.84	200	5	2600	52.30	0.492
RACCOON BEND COCKFIELD	34	155	840	68.17	0.47	33	40.9	10	14.29	200	5	4200	64.88	0.486
HARRIS	31	112	11	59.86	0.75	9	55	10	4.6	200	5	5900	64.23	0.482
SEELIGSON ZONE 19-B	41	179	546	60.69	0.94	24	16	10	3.62	200	5	6100	78.47	0.472
LA ROSA 5900	30	125.2	1682	83.14	0.72	29	24	10	8.99	200	5	5900	30.14	0.470
UNIV. BLOCK 9 PENN.	40	151	11	58.2	1.46	12	35	10	3.8	200	5	9000	90.81	0.465
SLAUGHTER	30	108	11	66.51	0.53	12	48	10	5.95	200	5	5000	47.18	0.462
HENDERSON	31	85	50	49.88	0.58	14	40	10	4.34	200	5	3100	44.58	0.454
FARGO 3900	41	109.2	100	58.2	0.97	17	22	10	3.38	200	5	3900	72.22	0.451
PAYTON	36	81	35	66.51	0.71	20	20	10	4.13	200	5	2000	62.96	0.448
GILLOCK EAST SEGMENT	39	224	1330	35.75	0.87	29	42.5	10	6.84	200	5	9600	51.11	0.448
MERCHANT EY-1B	30	205	230	65.68	0.6	31	28	10	8.85	200	5	8900	49.48	0.444
SHAMBURGER LAKE PALUXY	32	206	200	70.67	0.54	21	28	10	6.45	200	5	7300	44.88	0.435
LOMA NOVIA LOMA NOVIA	26	114	800	62.35	0.24	26	16	10	4.03	200	5	2600	37.92	0.433
SHAFTER LAKE SAN AND.	34	105	5	62.35	0.73	8	37	10	2.87	200	5	4400	70.57	0.428
KINGDOM ABO	30	121	5	64.02	0.83	7	70	10	4.87	200	5	7800	60.14	0.419
WEBSTER UPPER FRIO	29	163	2350	62.35	0.52	31	150	10	45.03	200	5	5800	56.31	0.416
KERMIT	34	83	14	54.04	0.73	15	22	10	2.77	200	5	2800	62.63	0.403
LUTHER S.E. SIL.-DEV.	44	168	16	66.51	1.86	15	65	10	10.07	200	5	9900	69.62	0.382
ARANSAS PASS	42	198	225	57.37	1.12	28	20	10	4.99	200	5	7100	74.73	0.374
LOVELL'S LAKE FRIO I	38	167	450	49.88	1.04	29	45	10	10.11	200	5	7700	81.14	0.371
DOLLARHIDE SILURIAN	42	120	9	64.85	1.94	6	194	10	11.72	200	5	8500	70.76	0.370
FLANAGAN U. CLFK.	32	113	3	60.69	0.61	13	45	10	5.51	200	5	6300	64.84	0.355

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
EMMA	33	104	11	63.85	0.58	7	58	10	4.03	200	5	4000	63.77	0.354
KMA	40	125	55	62.35	0.8	16	24	10	3.72	200	5	3700	72.54	0.350
WILLAMAR, W. W. WILLA.	31	212	65	53.21	0.59	19	34	10	5.34	200	5	7900	52.04	0.345
RUSSELL 7000 CLFK.	35	127	2	62.35	0.81	5	95	10	4.6	200	5	7000	78.96	0.335
TAFT 4000	23	133	1500	64.02	0.32	25	30	10	7.46	200	5	4000	36.24	0.326
TEX-HAMON FUSSELMAN	40	154	25	54.04	1.86	7	65	10	3.82	200	5	11600	87.54	0.325
UNIV. BLOCK 9 DEV.	45	176	3	69	2.03	5	107	10	5.73	200	5	10500	58.36	0.315
HAYNES MITCHELL	40	148	25	56.53	1.04	17	18	10	2.69	200	5	5900	82.49	0.313
LEA ELLENBURGER	43	138	300	78.15	1.88	2	202	10	4.9	200	5	8200	49.90	0.311
TUNSTILL	40	88	30	51.55	1.16	25	12	10	2.4	200	5	3300	67.97	0.310
HOBO	46	150	32	58.2	1.72	10	39	10	3.53	200	5	7100	69.67	0.292
TWOFREDS DELAWARE	35	104	33	46.56	1	20	21	10	3.04	200	5	4900	59.57	0.286
WALNUT BEND WINGER	32	143	309	69	0.69	17	21	10	3.83	200	5	5500	55.35	0.280
WILLAMAR WILLAMAR	30	200	140	62.35	0.59	23	20	10	4.45	200	5	7600	54.10	0.279
CAYUGA WOODBINE	29	160	500	66.51	0.23	25	35	10	9.04	200	5	4000	49.16	0.278
KEYSTONE ELLENBURGER	44	144	5	54.87	2.21	3	300	10	7.67	200	5	9600	67.51	0.272
HEYSER 5400	34	164	300	54.04	0.62	24	13	10	2.62	200	5	5400	70.06	0.264
MCELROY	32	86	50	65.51	0.61	16	86	10	14	200	5	2900	56.48	0.261
HOWARD-GLASSCOCK GLOR.	27	100	4	58.2	0.29	11	60	10	5.97	200	5	3200	43.33	0.257
GOLDSMITH NORTH	35	95	2	59.86	0.79	8	35	10	2.6	200	5	4400	74.79	0.253
WEST RANCH 98-A	40	178	497	58.2	0.88	30	32	10	8.68	200	5	6100	81.90	0.248
KEYSTONE HOLT	40	92	58	59.03	1.39	18	55	10	9.08	200	5	4800	84.55	0.246
HITTS LAKE PALUXY	26	175	400	74.82	0.49	22	32	10	8.18	200	5	7200	25.39	0.244
SHARON RIDGE 1700	28	90	3	52.38	0.26	15	35	10	4.27	200	5	1700	35.52	0.235
KELLY-SNYDER	42	130	19	64.85	1.56	8	137	10	11.04	200	5	6700	74.57	0.227
TOM O'CONNOR 5800	36	176	1758	69.84	0.67	32	16	10	5.55	200	5	5800	62.39	0.226
NEVA WEST STRAWN	46	158	8	59.86	1.38	10	80	10	7.44	200	5	6200	71.61	0.224
DOLLARHIDE ELL.	41	139	5	55.7	1.88	3	187	10	4.85	200	5	10000	80.67	0.201
AMROW DEVONIAN	35	178	34	58.2	1.29	4	131	10	4.74	200	5	12600	92.41	0.200
SEELIGSON ZONE 14-B	40	164	353	54.04	0.86	26	11	10	2.4	200	5	5100	75.19	0.196
LOLITA WARD ZONE	32	171	635	57.37	0.56	30	10	10	2.67	200	5	5900	66.20	0.194
ROUND TOP PALO PINTO	40	140	6	62.35	0.82	10	90	10	8.72	200	5	4800	79.32	0.182
FARMER	30	95.6	4	59.03	0.34	10	75	10	6.88	200	5	2200	52.99	0.175
DOLLARHIDE DEVONIAN	40	120	17	59.86	1.58	14	70	10	9.11	200	5	8000	87.15	0.172
GIDDINGS AUSTIN CHALK	40	225	0.1	36.58	0.94	6	150	10	5.11	200	5	7500	48.01	0.170
COGDELL	42	136	18	54.04	1.49	10	73	10	6.13	200	5	6800	77.31	0.166

Table 4.5.1. Ranking of Reservoirs With Positive Net Revenue (Continued)

FIELD	DEG. API	TEMP, F	PERM.	So,%	P/MMP	POR.,%	PAY	DIP	EOOIP	AREA	WELLS	DEPTH	TECH	ECON
DARST CREEK BUDA	32	95.6	0.1	42.4	0.3	12	90	10	7.11	200	5	2200	35.46	0.165
VAUGHN	28	90	10	51.63	0.21	14	30	10	3.37	200	5	1500	32.95	0.154
MABEE	32	106	8	48.22	0.67	11	40	10	3.3	200	5	4700	47.78	0.118
GRETA 4400	24	145	687	60.69	0.34	33	25	10	7.78	200	5	4400	43.28	0.113
SOJOURNER	41	120.4	15	58.2	1.13	14	19	10	2.4	200	5	5300	77.32	0.113
BEDFORD DEVONIAN	41	138	5	54.04	1.62	11	100	10	9.23	200	5	8800	80.88	0.112
FLOUR BLUFF PHILLIPS	44	186	745	49.88	1.2	31	25	10	6	200	5	6600	58.67	0.099
DIAMOND M	44	130	72	59.86	1.81	9	80	10	6.69	200	5	6600	73.91	0.097
COTTONWOOD CR. SOUTH	36	220	790	46.56	0.68	22	22	10	3.5	200	5	7600	53.73	0.087
DUNE	34	88	6	61.11	0.72	10	80	10	7.59	200	5	3300	71.63	0.085
ELIASVILLE POOL	39	115	8	62.35	0.59	12	27	10	3.14	200	5	3300	69.23	0.083
KILDARE RODESSA	40	158	27	66.51	0.86	16	17	10	2.81	200	5	6000	71.53	0.079
GARCIA GARCIA MAIN	47	152	1285	68.17	1.04	32	12	10	4.07	200	5	3800	48.18	0.079
NOLLEY WOLFCAMP	37	130	20	59.86	1.51	9	60	10	5.02	200	5	9100	94.07	0.076
OCEANIC	42	160	84	68.17	1.37	12	60	10	7.62	200	5	8100	74.15	0.075
HEADLEE ELLENBURGER	51	208	40	66.51	3.71	2	325	10	6.71	200	5	13300	42.67	0.071
BIG LAKE	36	125	20	66.51	0.45	19	30	10	5.89	200	5	3000	64.17	0.069
SPRABERRY TREND	39	132	0.3	54.04	1.02	10	25	10	2.1	200	5	6800	78.46	0.065
KATZ 5100	37	120	56	53.21	0.89	16	35	10	4.63	200	5	5100	75.02	0.055
ELKHORN ELLENBURGER	39	179	34	83.14	0.93	2	121	10	3.12	200	5	7200	57.78	0.054
CHOCOLATE BAYOU U. FRIO	42	212	1090	54.87	1.23	28	27	10	6.44	200	5	8800	71.74	0.049
FULLERTON SOUTH ELL.	44	132	77	70.67	2.54	2	275	10	6.04	200	5	10700	51.77	0.048
HARPER ELLENBURGER	46	163	2	58.2	2.4	2	225	10	4.07	200	5	12300	66.66	0.043
SAND HILLS TUBB	35	96	30	49.88	0.96	12	47	10	4.37	200	5	4500	67.73	0.04
FARNSWORTH U. MORROW	38	170	48	57.37	0.65	15	21	10	2.81	200	5	7900	78.05	0.04
FULLERTON 8500 DEV.	45	120	50	62.35	2.49	8	40	10	3.1	200	5	8500	66.43	0.034
CROSSETT SOUTH DEV.	42	107	3	49.88	1.55	19	80	10	11.78	200	5	5600	64.33	0.022
BOYD CONGL.	40	136	55	54.04	1.09	14	27	10	3.17	200	5	6000	78.88	0.012
TOMBALL KOBS	40	182	1000	57.37	0.77	31	6.5	10	1.8	200	5	5500	74.44	0.008
EL MAR DELAWARE	41	114	14	45.73	1.16	22	15	10	2.34	200	5	4500	56.33	0.008
MAGNET-WITHERS	26	171	1700	60.69	0.4	29	67	10	18.31	200	5	5600	50.33	0.002

5.0 Conclusions

Of the 431 reservoirs screened, 211 projected revenue that exceeded cost, i.e., were profitable. Only the top 154 reservoirs, however, showed a profit greater than 30 percent. The top ten reservoirs predicted a profit of at least 80 percent. Six of the top ten were Gulf Coast sandstones.

The reservoirs are representative of the most productive discoveries in Texas. They account for approximately 72 percent of the recorded 52 billion barrels of oil production in the State. The preliminary evaluation of the reservoirs performed in this study implied that potential production from CO_2-EOR could be as much as 4 billion barrels.

In order to enhance the chances of achieving this increase in production, the Department of Energy should consider a concerted effort to follow up this analysis with a targeted outreach program to the specific independent operators controlling the leases applicable to these reservoirs/resources. Development of ownership/technical potential maps and an outreach program should be initiated to aid this identification.

Bibliography

Alston, R. B., Kokolis, G. P., and James, C. F.: "CO_2 Minimum Miscibility Pressure: A Correlation for Impure CO_2 Streams and Live Oil," paper SPE 11959 presented at the 1983 SPE Annual Technical Conference and Exhibition, San Francisco, Oct. 5-8.

Brinlee, L. D. and Brandt, J. A.: "Planning and Development of the Northeast Purdy Springer CO_2 Miscible Project," paper SPE 11163 presented at the 1982 SPE Annual Technical Conference and Exhibition, New Orleans, Sep. 26-29.

Brock, W. R. and Bryan, L. A.: "Summary Results of CO_2 EOR Field Tests, 1972-1987," paper SPE 18977 presented at the SPE Joint Rocky Mountain Regional/Low Permeability Reservoirs Symposium and Exhibition, Denver, March 6-8, 1989.

Brummert, A. C., et al.: "Rock Creek Oil Field CO_2 Pilot Tests, Roane County, West Virginia," JPT (March 1988) 339-347.

Claridge, E. L., Jr., "Carbon Dioxide Flooding Strategy in a Communicating Layered Reservoir," SPEJ (April 1972) 143-154.

Cobb, L. B. : "Target Reservoirs Got CO_2 Miscible Flooding - Task Two: Summary of Available Reservoir and Geologic Data", Vol. 1, Parts 1-4; U.S. Department of Energy, Report DOE/MC/08341-31, p. 1119 (1981).

Craig, F. F.: The Reservoir Engineering Aspects of Waterflooding, Monograph Series, SPE, Dallas, (1971).

Davis, D. W.: "Project Design of a CO_2 Miscible Flood in a Waterflooded Sandstone Reservoir," paper SPE 27758 presented at the SPE/DOE Ninth Symposium on Improved Oil Recovery, Tulsa, April 17-20, 1994.

Diaz, Daniel Arturo: "Screening Criteria for Application of Carbon Dioxide Miscible Displacement in Waterflooded Reservoirs Containing Light Oil", M.S. Thesis, Louisiana State University, (1995).

Dobitz, J. K. and Prieditis, J.: "A Stream Tube Model for the PC," paper SPE 27750 presented at the SPE/DOE Ninth Symposium on Improved Oil, Tulsa, April 17-20, 1994.

Flanders, W. A., McGinnis, R. A., and Shatto, A. G.: "CO_2 EOR Economics for Small to Medium Size Fields," paper SPE 26391 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3-6.

Flanders, W. A. and DePauw, R. M.: "Update Case History: Performance of the Twofreds Tertiary CO_2 Project," paper SPE 26614 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3-6.

Fox, M. J., Simlote, V. N., and Beaty, W. G.: "Evaluation of CO_2 Flood Performance, Springer A Sand, NE Purdy Unity, Garvin County, OK," paper SPE 12665 presented at the SPE/DOE Fourth Symposium on Enhanced Oil Recovery, Tulsa, April 15-18, 1984.

Fox, M., et al.: "Review of CO_2 Flood, Springer A Sand, Northeast Purdy Unit, Garvin County, Oklahoma," SPE Reservoir Engineering (Nov. 1988) 1161-1167.

Goodrich, J. H.: "Review and Analysis of Past and Ongoing Carbon Dioxide Injection Field Tests," paper SPE 8832 presented at the SPE/DOE Sixth Symposium on Improved Oil Recovery, Tulsa, April 20-23, 1980.

Grue, D. J. and Zana, E. T.: "Study of a Possible CO_2 Flood in Rangely Weber," JPT (July 1981) 1312-1318.

Hadlow, R. E.: "Update of Industry Experience with CO_2 Injection," paper SPE 24928 presented at the 1992 SPE Annual Technical Conference and Exhibition, Washington, D.C., Oct. 4-7.

Hallenbeck, L. D., et al.: "Innovative Approach to CO_2 Project Development Holds Promise for Improving CO_2 Flood Economics in Smaller Fields Near Abandonment," paper SPE 28334 presented at the 1994 SPE Annual Technical Conference and Exhibition, New Orleans, Sep. 25-28.

Hansen, P. W.: "A CO_2 Tertiary Recovery Pilot: Little Creek Field, Mississippi," paper SPE 6747 presented at the 1977 SPE Annual Technical Conference and Exhibition, Denver, Oct. 9-12.

Haynes, H. J., et al.: Enhanced Oil Recovery, National Petroleum Council, Washington, D.C. (1976).

Hervey, J. R. and Iakovakis, A. C.: "Performance Review of a Miscible CO_2 Tertiary Project: Rangely Weber Sand Unit, Colorado," paper SPE 19653 presented at the 1989 SPE Annual Technical Conference and Exhibition, San Antonio, Oct. 8-11.

Hicks, J.M., and Foster, R.S.: "Evaluation of Target Oil and 50 Major Reservoirs in the Texas Gulf Coast for Enhanced Oil Recovery," U.S. Department of Energy Report DOE/EIA/0037-162P (1980).

Hoiland, R. C., Joyner, H. D., and Staldr, J. : "Case History of a Successful Rocky Mountain Pilot CO_2 Flood," paper SPE 14939 presented at the SPE/DOE Fifth Symposium on Enhanced Oil Recovery, Tulsa, 20-23, 1986.

Holm, L. W. and Josendal, V. A.: "Study Shows Best Use of CO_2 as EOR Agent," Oil & Gas Journal (Oct. 22, 1984) 131-134.

Holm, L. W. and Josendal, V. A.: "Mechanisms of Oil Displacement by Carbon Dioxide," JPT (Dec. 1974) 1427-1436.

Holm, L. W.: "Miscibility and Miscible Displacement," JPT (Aug. 1986) 817-818.

Holm, L.W., "Evolution of the Carbon Dioxide Process," JPT (Nov. 1987) 1337-1342.

Hsie, J. C. and Moore, J. S.: "The Quarantine Bay 4RC CO_2 WAG Pilot Project: A Postflood Evaluation," SPE Reservoir Engineering (Aug. 1988) 809-814.

Kirkpatrick, R. K., Flanders, W. A., and DePauw, R. M.: "Performance of the Twofreds CO_2 Injection Project." paper SPE 14439 presented at the 1985 SPE Annual Technical Conference and Exhibition, Las Vegas, Sep. 22-25.

Kleinstelber, S. W.: "The Wertz Tensleep CO_2 Flood: Design and Initial Performance," JPT (May 1990) 630-636.

Klins, M. A.: Carbon Dioxide Flooding, IHRDC, Boston, 1984.

Koemer, R. H.: "Connections with Time," JPT (Jan. 1995) 5-6.

Koval, D. J.: "A Method for Predicting the Performance of Unstable Miscible Displacement in Heterogeneous Media," SPEJ (June 1963) 145-154.

Kumar, R. and Einbeck, J. N.: "CO_2 Flooding a Waterflooded Shallow Pennsylvanian Sand in Oklahoma: A Case History," paper SPE 12668 presented at the SPE/DOE Fourth Symposium on Enhanced Oil Recovery, Tulsa, April 15-18, 1984.

Leach, M.P. and Yellig, W. F.: "Compositional Model Studies - CO_2/Oil-Displacement Mechanism," SPEJ (Aug. 1979) 89-97.

Lewin and Associates, Inc.: "The Potential and Economics of Enhanced Oil Recovery," prepared under U.S. FEA Contract No. C0-03-50222-000, Washington, D.C. (April 1976).

Martin, F. D. and Taber, J. J.: "Carbon Dioxide Flooding," JPT (April 1992) 396-400.

Martin, F. D.: "Enhanced Oil Recovery for Independent Producers," paper SPE 24142 presented at the SPE/DOE Eighth Symposium on Enhanced Oil Recovery, Tulsa, April 22-24, 1992.

Metcalfe, R. S. and Yarborough, L.: "The Effect of Oil Phase Equilibria on the CO_2 Displacement Mechanism," SPEJ (Feb. 1981) 89-97.

Moritis, G.: "EOR Dips in U.S. But Remains a Significant Factor, Oil & Gas Journal, (Sep. 26, 1994) 51-79.

Mungan, N.: "An Evaluation of Carbon Dioxide Flooding," paper SPE 21761 presented at the SPE Western Regional Meeting, Long Beach, March 20-22, 1991.

Mungan, N.: "Enhanced Oil Recovery Using Water as a Driving Fluid. Part 7 - Field Applications of Carbon Dioxide Flooding," World Oil (Aug. 1981) 69-84.

Mungan, N.: "Enhanced Oil Recovery Using Water as a Driving Fluid. Part 6 - Fundamental Aspects of Carbon Dioxide Flooding," World Oil (Aug., 1981) 69-84.

Mungan, N.: "Enhanced Recovery Under Constrained Conditions," JPT (Aug. 1990) 962-964.

Orr, F. M., Jr. and Silva, M. K.: "Effect of Oil Composition on Minimum Miscibility Pressure -- Part 2: Correlation," SPERE (Nov. 1987) 479-491.

Paul, G. W., Lake, L. W., and Gould, T. L.: "A Simplified Model for CO_2 Miscible Flooding," paper SPE 13238 presented at the 1984 SPE Annual Technology Conference and Exhibition, Houston, Sep. 5-8.

Philips, L. A., McPherson, J. L. and Leibrecht, R. J.: "CO_2 Flood: Design and Initial Operations, Ford Geraldine (Delaware Sand) Unit," paper SPE 12197 presented at the 1983 SPE Annual Technical Conference and Exhibition, San Francisco, Oct. 5-8.

Pittaway, K. R. and Rosato, R. J.: "The Ford Geraldine Unit CO_2 Flood -- Update 1990," SPE Reservoir Engineering (Nov. 1991) 410-414.

Rickford, R. L. and Finney, T. P.: "Formation Damage From Fine Particulate Invasion: An Example from the Lost Soldier Tensleep Formation," SPEPE (Aug. 1991) 247.

Rivas, O., Embid, S., and Boliver, F." "Ranking Reservoirs for CO_2 Flooding Processes," SPE paper 23641 presented at the 1992 SPE Latin American Petroleum Engineering Conference, Caracas, March 8-11.

Robl, F. W., Emanuel, A. S. and Van Meter, Jr., O. J.: "The 1984 National Petroleum Council Estimate of Potential EOR for Miscible Process," JPT (Aug. 1986) 875-882.

Sebastian, H. M., Wenger, R. S., and Renner, T. A.: "Correlation of Minimum Miscibility Pressure for Impure CO_2 Streams," JPT (Nov. 1985) 2076-2082.

Simlote, V. N. and Withjack, E. M.: "Estimation of Tertiary Recovery by CO_2 Injection -- Springer A Sand, Northeast Purdy Unit." JPT (May 1981) 808-818.

Smith, D. L.: "Computer Graphical Analysis Method Proves Beneficial in Lost Soldier Field Deviated Well Application," JPT (June 1982) 1186.

Stalkup, F. I., Jr.: "Displacement of Oil by Solvent at High Water Saturation," SPEJ (Dec. 1970) 337-348.

Stalkup, F. I.: "Carbon Dioxide Miscible Flooding: Past, Present, and Outlook for the Future," JPT (Aug. 1978) 1102-1112.

Texas Railroad Commission: "A Survey of Secondary and Enhanced Recovery Operations in Texas to 1980," Austin TX, 554P.

Texas Railroad Commission: "1981 Annual Report," Austin TX.

Todd, M. R. and Longstaff, W. J.: "The Development, Testing and Application of a Numerical Simulator for Predicting Miscible Flood Performance," JPT (July 1972) 874-882, Trans., AIME, 253.

Trash, J. C.: "Twofreds Field: A Tertiary Oil Recovery Project," paper SPE 8382 presented at the 1979 SPE Annual Technical Conference and Exhibition, Dallas, Sep. 23-26.

Willhite, P. G.: Waterflooding, SPE Textbook Series Vol. 3, Society of Petroleum Engineers, Richardson (1986) 208.

Winzinger, R., et al.: "Design of a Major CO_2 Flood, North Ward Estes Field, Ward County, Texas," SPE Reservoir Engineering (Aug. 1988) 809-814.

Yellig, W. F. and Metcalfe, R. S.: "Determination and Prediction of the CO_2 Minimum Miscibility Pressures," JPT (Jan. 1980) 160-168.

Youngren, G. K. and Charlson, G. S.: "History Match of the Little Creek CO_2 Pilot Test," JPT (Nov. 1980) 2042-2052.

References

1. Rivas, O., Embid S., and Bolivar, F., "Ranking Reservoirs for CO_2 Flooding Processes," SPE Paper 23641 presented at the 1992 SPE Latin American Conference, Caracas, Venezuela, March 8-11.

2. Diaz, Daniel Arturo, "Screening Criteria for Application of Carbon Dioxide Miscible Displacement in Waterflooded Reservoirs Containing Light Oil," M.S. thesis, Louisiana State University, (1995).

3. Oil and Gas Journal, International Petroleum Encyclopedia, 1995, Vol. 28.

4. Diaz, Daniel Arturo, M.S. thesis, Louisiana State University, (1995).

5. Martin, F.D. and Taber, J.J., "Carbon Dioxide Flooding," Journal of Petroleum Technology (April 1992), pp. 396-400.

6. Anada, H., King, D., Seskus, A., and Fraser, M., "Feasibility and Economics of By-Product CO_2 Supply for Enhanced Oil Recovery, Final SAIC Report to Morgantown Energy Technology Center, 1982.

7. Klins, M.A.: Carbon Dioxide Flooding, IHRDC, Boston, 1984.

8. Lewin and Associates, Inc.: "The Potential and Economics of Enhanced Oil Recovery," prepared under U.S. FEA Contract No. C0-03-50222-000, Washington, D.C. (April 1976).

9. Flanders, W. A., McGinnis, R. A., and Shatto, A. G.: "CO_2 EOR Economics for Small to Medium Size Fields," paper SPE 26391 presented at the 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3-6.

10. Klins, M.A.: IHRDC, Boston, 1984.

11. Lewin and Associates, Inc.: Washington, D.C. (April 1976).

12. Martin, F. D.: "Enhanced Oil Recovery for Independent Producers," paper SPE 24142 presented at the SPE/DOE Eighth Symposium on Enhanced Oil Recovery, Tulsa, April 22-24, 1992.

13. Flanders, W. A.: 1993 SPE Annual Technical Conference and Exhibition, Houston, Oct. 3-6.

14. Haynes, H. J., et al.: Enhanced Oil Recovery, National Petroleum Council, Washington, D.C. (1976).

15. Martin, F. D.: Eighth Symposium on Enhanced Oil Recovery, Tulsa, April 22-24, 1992.

16. Robl, F. W., Emanuel, A. S. and Van Meter, Jr., O. J.: "The 1984 National Petroleum Council Estimate of Potential EOR for Miscible Process," JPT (Aug. 1986) 875-882.

Appendix A

Texas Reservoir Database

Table A1. Texas Reservoir Database

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42163	BIG FOOT OLMOS B	1	GULF COAST BASIN	OLMOS	SS	SG	3300.0	13.0	580	3.00	43.00	31.33
42127	BIG WELLS SAN MIGUEL	1	GULF COAST BASIN	SAN MIGUEL	SS	SG+LGCE	5400.0		200	6.00	33.00	54.58
42013	CHARLOTTE NAVARRO	1	GULF COAST BASIN	NAVARRO	SS	SG+MGCE	5100.0	20.0	260	20.00	34.00	40.24
42187	DARST CREEK BUDA	1	GULF COAST BASIN	BUDA LIME	LS	SG	2200.0	90.0		0.10	32.00	63.20
42187	DARST CREEK EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2600.0	150.0	200	200.00	36.00	93.50
42013	JOURDANTON EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD+MGCE	7300.0	55.0	400	23.00	38.00	13.60
42055	LULING-BRANYON AUSTIN	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG	1900.0	30.0	300	0.10	36.00	160.75
42055	LULING-BRANYON EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2200.0	0.0	150	200.00	36.00	138.00
42055	LYTTON SPRINGS	1	GULF COAST BASIN	TAYLOR	TUFF	SG+GD	1300.0	0.0		7.00	38.00	11.27
42163	PEARSALL AUSTIN CHALK	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG,GD	5300.0	40.0		0.10	28.00	72.75
42323	SACATOSA SAN MIGUEL	1	GULF COAST BASIN	SAN MIGUEL	SS	SG	1200.0	22.0	615	4.00	32.00	30.36
42055	SALT FLAT AUSTIN CHALK	1	GULF COAST BASIN	AUSTIN CHALK	LS	SG	2400.0	120.0	500	0.10	36.00	78.57
42055	SALT FLAT EDWARDS	1	GULF COAST BASIN	EDWARDS	DO,LS	WD	2725.0	15.0			30.00	63.70
42013	SOMERSET OLMOS B	1	GULF COAST BASIN	OLMOS	SS	SG	1000.0	10.0		85.00	34.00	26.28
42013	WEIGANG CARRIZO	1	GULF COAST BASIN	CARRIZO WILCOX	SS	WD	3900.0	30.0		1357.00	24.00	11.19
42175	BERCLAIR VICKSBURG	2	GULF COAST BASIN	VICKSBURG	SS	COMBINED	3200.0		23	1000.00	27.00	12.13
42469	BLOOMINGTON 4600	2	GULF COAST BASIN	GRETA	SS	WD	4600.0	20.0	40	1140.00	23.00	31.57
42391	BONNIE VIEW	2	GULF COAST BASIN	GRETA	SS	WD	4500.0	24.0	30	1000.00	24.00	19.62
42123	COTTONWOOD CR. SOUTH	2	GULF COAST BASIN	WILCOX	SS	WD+GCE	7600.0	22.0	20	790.00	36.00	11.09
42255	FALLS CITY LBAR., LPA.	2	GULF COAST BASIN	LOWER WILCOX	SS	WD	6100.0	25.0	50	371.00	39.00	25.40
42239	FRANCITAS NORTH	2	GULF COAST BASIN	FRIO	SS	COMBINED	8500.0		18	1800.00	49.00	11.81
42239	GANADO WEST 4700	2	GULF COAST BASIN	GRETA	SS	WD	4700.0	44.0	80	1411.00	24.00	27.60
42391	GRETA 4400	2	GULF COAST BASIN	FRIO	SS	WD	4400.0	25.0	65	687.00	24.00	133.23
42469	HELEN GOHLKE WILCOX	2	GULF COAST BASIN	WILCOX	SS	WD+GCE	8100.0	47.0	65	180.00	34.00	24.18
42057	HEYSER 5400	2	GULF COAST BASIN	FRIO	SS	WD+MSG	5400.0	13.0	36	300.00	34.00	10.40
42391	LA ROSA 5400	2	GULF COAST BASIN	FRIO	SS	WD	5400.0		39	0.00	30.00	10.00
42391	LA ROSA 5900	2	GULF COAST BASIN	FRIO	SS	WD+GCE	5900.0	24.0	25	1682.00	30.00	15.53
42239	LA WARD NORTH	2	GULF COAST BASIN	MARGINULINA	SS	GCE+MWD	5200.0	18.0	33	350.00	26.00	19.52
42391	LAKE PASTURE H-440 S	2	GULF COAST BASIN	UPPER GRETA	SS	WD+SG	4500.0	75.0	50	1197.00	24.00	51.82
42239	LOLITA MARGINULINA	2	GULF COAST BASIN	MARGINULINA	SS	WD+PSG	5300.0	7.0	25	164.00	26.00	15.56
42239	LOLITA WARD ZONE	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	10.0	30	635.00	32.00	14.36
42239	MAURBRO MARGINULINA	2	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5200.0	9.0	34	450.00	25.00	26.03
42469	MCFADDIN 4400	2	GULF COAST BASIN	GRETA	SS	WD	4400.0	40.0	53	287.00	25.00	30.33
42391	M. E. O'CONNOR FQ-40	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	20.0		820.00	40.00	18.07
42255	PERSON EDWARDS	2	GULF COAST BASIN	EDWARDS	DO,LS	GCE	10850.0	30.0	120	2.60	40.00	16.65
42025	PETTUS PETTUS	2	GULF COAST BASIN	PETTUS	SS	GCE	3900.0	16.0	81	452.00	44.00	16.54

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42469	PLACEDO 4700 SAND	2	GULF COAST BASIN	GRETA	SS	WD	4700.0	0.0	40	847.00	24.00	43.08
42123	SLICK WILCOX	2	GULF COAST BASIN	WILCOX	SS	WD+MGCE	7300.0	50.0	50	350.00	36.00	19.91
42391	TOM O'CONNOR 4400	2	GULF COAST BASIN	FRIO	SS	SG+WD	4400.0	4.2	15	578.00	24.00	14.22
42391	TOM O'CONNOR 4500 GR.	2	GULF COAST BASIN	GRETA	SS	WD	4500.0	20.0	20	2290.00	24.00	18.90
42391	TOM O'CONNOR 5500	2	GULF COAST BASIN	LOWER FRIO	SS	SG+PWD	5500.0	26.0	80	816.00	31.00	113.50
42391	TOM O'CONNOR 5800	2	GULF COAST BASIN	FRIO	SS	COMBINED	5800.0	16.0	200	1758.00	36.00	248.16
42391	TOM O'CONNOR 5900	2	GULF COAST BASIN	FRIO	SS	WD	5900.0	30.0	150	2136.00	35.00	262.77
42239	WEST RANCH 41-A	2	GULF COAST BASIN	FRIO	SS	WD	5700.0	35.0	60	869.00	32.00	99.04
42239	WEST RANCH 98-A	2	GULF COAST BASIN	FRIO	SS	WD	6100.0	32.0	70	497.00	40.00	59.00
42239	WEST R'NCH GLASSCOCK	2	GULF COAST BASIN	FRIO	SS	GCE+WD	5500.0	36.0	95	394.00	31.00	45.74
42239	WEST RANCH GRETA	2	GULF COAST BASIN	GRETA	SS	WD	5100.0	33.0	48	1000.00	24.00	99.24
42239	WEST RANCH WARD	2	GULF COAST BASIN	FRIO	SS	WD+GCE	5700.0	13.0	30	1228.00	31.00	30.28
42245	AMELIA FRIO 6	3	GULF COAST BASIN	FRIO	SS	WD+GCE	6800.0	12.0	20	1390.00	30.00	27.50
42071	ANAHUAC MAIN FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7100.0	66.0	125	1085.00	35.00	275.87
42199	BATSON CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	1100.0	26.0			30.00	44.94
42071	CEDAR POINT FRIO 5900	3	GULF COAST BASIN	FRIO	SS	WD+GCE	6000.0	9.0	75	900.00	38.00	18.56
42039	CHOCOLATE BAYOU, ALI.	3	GULF COAST BASIN	ALIBEL FRIO	SS	WD	9400.0	26.0	52	400.00	42.00	14.43
42039	CHOCOLATE BAYOU, U.F.	3	GULF COAST BASIN	UPPER FRIO	SS	GCE+WD	8800.0	27.0	20	1090.00	42.00	17.45
42201	CLEAR LAKE FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5900.0	40.0	60	977.00	26.00	23.99
42339	CONROE MAIN CONROE	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5200.0	65.0	160	1400.00	38.00	706.37
42201	DURKEE FAIRBANKS	3	GULF COAST BASIN	FAIRBANKS	SS	WD+GCE	7100.0	25.0	40	2400.00	35.00	13.24
42291	ESPERSON DOME S. CROCKETT	3	GULF COAST BASIN	CROCKETT	SS	COMBINED	7300.0	176.0	1800	240.00	39.00	17.34
42201	FAIRBANKS FAIRBANKS	3	GULF COAST BASIN	YEGUA	SS	GCE	6800.0	91.0	26	2000.00	36.00	41.24
42071	FIG RIDGE SEABREEZE	3	GULF COAST BASIN	FRIO	SS	SG+WD	8500.0	34.0	100	750.00	35.00	48.77
42287	GIDDINGS AUSTIN CHALK	3	GULF COAST BASIN	AUSTIN CHALK	LS	SG	7500.0	150.0		0.10	40.00	193.47
42167	GILLOCK BIG GAS	3	GULF COAST BASIN	FRIO	SS	COMBINED	8400.0	25.0	505	1470.00	38.00	34.01
42167	GILLOCK EAST SEGMENT	3	GULF COAST BASIN	FRIO	SS	WD	9600.0	42.5	370	1330.00	39.00	21.94
42167	GILLOCK, S. BIG GAS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	9600.0	36.0	574	900.00	38.00	45.46
42291	HARDIN FRAZIER	3	GULF COAST BASIN	COCKFIELD	SS	WD	7900.0	26.0	100	500.00	38.00	22.35
42039	HASTINGS, E. U. FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	WD+GCE	6100.0	8.0	145	720.00	32.00	56.88
42039	HASTINGS, W. FRIO	3	GULF COAST BASIN	FRIO	SS	COMBINED	6100.0	163.0	625	865.00	31.00	619.15
42201	HOUSTON, S. FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	4800.0	0.0	295	710.00	27.00	42.37
42201	HOUSTON, S. MIOCENE	3	GULF COAST BASIN	MIOCENE	SS	WD+GCE	4000.0	0.0	180	100.00	22.00	14.90
42201	HUMBLE CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	1200.0	80.0		0.00	22.00	168.13
42473	KATY I-B	3	GULF COAST BASIN	YEGUA	SS	GCE+WD	6600.0	18.0	12	1050.00	43.00	15.10

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42041	KURTEN WOODBINE	3	EAST TEXAS	WOODBINE	SS	SG	8300.0	27.0		2.00	38.00	13.76
42373	LIVINGSTON WILCOX	3	GULF COAST BASIN	WILCOX	SS	WD	7400.0	81.0	80	70.00	35.00	19.95
42373	LIVINGSTON YEGUA	3	GULF COAST BASIN	YEGUA	SS	WD+GCE	4500.0	15.0	45	120.00	40.00	20.66
42245	LOVELL'S LAKE FRIO 1	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7700.0	45.0	10	450.00	38.00	10.30
42245	LOVELL'S LAKE FRIO 2	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7900.0	0.0	50	454.00	38.00	17.03
42481	MAGNET-WITHERS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5600.0	67.0	20	1700.00	26.00	91.99
42039	MANVEL F.B. I OLIG.	3	GULF COAST BASIN	OLIGOCENE	SS	WD+GCE	5100.0	48.0	129	500.00	28.00	42.32
42039	MANVEL F.B. II OLIG.	3	GULF COAST BASIN	OLIGOCENE	SS	WD+GCE	5700.0	48.0	126	500.00	28.00	34.14
42321	MARKHAM N.-BCN CARLSON	3	GULF COAST BASIN	FRIO	SS	WD+GCE	7000.0		25	3333.00	36.00	13.81
42321	MARKHAM N.-BCN CORNELIUS	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8400.0		40	750.00	36.00	18.19
42291	MERCHANT EY-1B	3	GULF COAST BASIN	YEGUA	SS	COMBINED	8900.0	28.0	918	230.00	30.00	23.21
42407	MERCY 8260 WILCOX	3	GULF COAST BASIN	WILCOX	SS	WD	8300.0	15.0	37	256.00	38.00	13.33
42039	OLD OCEAN ARMSTRONG	3	GULF COAST BASIN	FRIO	SS	GCE	10000.0		83	251.00	37.00	68.09
42039	OLD OCEAN CHENAULT	3	GULF COAST BASIN	FRIO	SS	GCE	9600.0	60.0	60	640.00	36.00	10.16
42071	OYSTER BAYOU SEABREEZE	3	GULF COAST BASIN	SEABREEZE	SS	WD+GCE	8300.0	150.0	177	1325.00	36.00	138.19
42481	PICKETT RIDGE	3	GULF COAST BASIN	FRIO	SS	WD+GCE	4700.0	10.0	80	312.00	25.00	16.08
42015	RACCOON BEND COCKFIELD	3	GULF COAST BASIN	COCKFIELD	SS	WD	4200.0	40.9		840.00	34.00	59.00
42373	SEGNO YEGUA	3	GULF COAST BASIN	YEGUA	SS	COMBINED	5200.0		10	713.00	41.00	11.52
42373	SEGNO, DEEP WILCOX	3	GULF COAST BASIN	UPPER WILCOX	SS	SG+WD	8200.0				38.00	14.90
42199	SILSBEE FIRST YEGUA	3	GULF COAST BASIN	YEGUA	SS	WD+GCE	7000.0	0.0	25	500.00	41.00	23.63
42199	SOUR LAKE CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	600.0	20.0			22.00	132.75
42245	SPINDLETOP CAPROCK	3	GULF COAST BASIN	CAPROCK	LS	GCE+GD	800.0	40.0			22.00	154.68
42321	SUGAR VALLEY N. LAURENCE	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8900.0	0.0	37	600.00	32.00	6.30
42157	SUGARLAND UPPER FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	GCE+WD	3800.0	85.0	575	900.00	29.00	73.25
42157	THOMPSON FRIO	3	GULF COAST BASIN	FRIO	SS	WD+GCE	5400.0	40.0	250	1100.00	25.00	360.42
42157	THOMPSON, N. U. VICKSBURG	3	GULF COAST BASIN	UPPER VICKSBURG	SS	WD+SG	7800.0		150	3400.00	36.00	28.28
42157	THOMPSON, S. 4400	3	GULF COAST BASIN	MIOCENE	SS	WD	4400.0	35.0	130	367.00	25.00	24.80
42157	THOMPSON, S. 5400	3	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5300.0	29.0	80	900.00	25.00	10.70
42201	TOMBALL KOBS	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5500.0	6.5	20	1000.00	40.00	59.55
42201	TOMBALL SCHULTZ SE	3	GULF COAST BASIN	COCKFIELD	SS	WD+GCE	5500.0	11.0	20	1200.00	40.00	37.20
42071	TRINITY BAY FRIO 12	3	GULF COAST BASIN	FRIO	SS	WD+GCE	8100.0	7.0	11	2344.00	36.00	24.16
42071	TURTLE BAY MIDDLETON	3	GULF COAST BASIN	FRIO	SS	WD	6600.0	10.0	40	1000.00	31.00	12.29
42201	WEBSTER UPPER FRIO	3	GULF COAST BASIN	UPPER FRIO	SS	WD+GCE	5800.0	150.0	400	2350.00	29.00	571.50
42481	WITHERS NORTH	3	GULF COAST BASIN	MARGINULINA	SS	WD+GCE	5300.0	16.0	70	2500.00	26.00	50.30
42007	ARANSAS PASS	4	GULF COAST BASIN	FRIO	SS	SG+MWD	7100.0	20.0	16	225.00	42.00	20.27
42355	ARNOLD DAVID CHAPMAN	4	GULF COAST BASIN	FRIO	SS	WD	6100.0	20.0	69	917.00	42.00	10.52

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42479	AVIATORS MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	SG+WD	1700.0	13.0	51	357.00	21.00	10.37
42247	COLORADO COCKFIELD	4	GULF COAST BASIN	COCKFIELD	SS	SG	2600.0		300	800.00	45.00	21.91
42131	CONOCO DRISCOLL U.1G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	GCE	2800.0	12.0	54	458.00	33.00	29.44
42505	ESCOBAS MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	SG	1200.0	17.0	70	500.00	23.00	13.07
42355	FLOUR BLUFF PHILLIPS	4	GULF COAST BASIN	FRIO	SS	GCE+WD	6600.0	25.0	20	745.00	44.00	18.73
42427	GARCIA GARCIA MAIN	4	GULF COAST BASIN	VICKSBURG	SS	LWD+GCE	3800.0	12.0	80	1285.00	47.00	29.18
42131	GOVT. WELLS, NORTH G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG+WD	2200.0	20.0	60	800.00	21.00	80.03
42131	GOVT. WELLS, SOUTH G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG	2300.0		89	600.00	21.00	18.15
42131	HOFFMAN DOUGHERTY	4	GULF COAST BASIN	JACKSON	SS	SG	2000.0	10.0	250	757.00	23.00	48.81
42247	KELSEY M-2	4	GULF COAST BASIN	CATAHOULA	SS	GCE+SG	4700.0	16.0	93	454.00	47.00	10.80
42131	LOMA NOVIA LOMA NOVIA	4	GULF COAST BASIN	LOMA NOVIA	SS	SG	2600.0	16.0	240	800.00	26.00	48.61
42355	LONDON GIN DOUGHTY	4	GULF COAST BASIN	CATAHOULA	SS	WD	4500.0	14.0	47	1698.00	32.00	14.40
42479	LOPEZ FIRST MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	COMBINED	2200.0	15.0	70	250.00	22.00	31.35
42409	MIDWAY MAIN MIDWAY	4	GULF COAST BASIN	MIDWAY	SS	WD+GCE	5300.0	25.0	15	4500.00	27.00	16.60
42479	MIRANDO CITY MIRANDO	4	GULF COAST BASIN	MIRANDO	SS	COMBINED	1600.0	26.0	35	1600.00	21.00	12.30
42479	O'HERN PETTUS	4	GULF COAST BASIN	PETTUS	SS	SG	2700.0	23.0	200	286.00	28.00	22.46
42131	PIEDRE LUMBRE G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	WD+SG	1900.0	15.0	65	300.00	22.00	21.13
42409	PLYMOUTH HEEP	4	GULF COAST BASIN	FRIO	SS	WD+GCE	5600.0	28.0	30	3300.00	31.00	53.40
42409	PORTILLA 7300	4	GULF COAST BASIN	FRIO	SS	WD	7300.0	10.0	44	1412.00	40.00	12.61
42409	PORTILLA 7400	4	GULF COAST BASIN	FRIO	SS	WD	7400.0	28.0	130	1634.00	40.00	44.84
42247	PRADO MIDDLE LOMA NOVIA	4	GULF COAST BASIN	LOMA NOVIA	SS	SG+GCE	3700.0	10.0	65	850.00	40.00	23.66
42427	RINCON FRIO D-5	4	GULF COAST BASIN	FRIO	SS	COMBINED	3800.0	13.0	149	206.00	38.00	8.10
42427	RINCON FRIO E1+E2	4	GULF COAST BASIN	FRIO	SS	GCE	4000.0	10.0	157	161.00	40.00	9.70
42427	RINCON VICKSBURG SAND	4	GULF COAST BASIN	VICKSBURG	SS	COMBINED	5300.0	50.0	570	284.00	44.00	17.83
42249	SEELIGSON ZONE 10	4	GULF COAST BASIN	FRIO	SS	GCE+LWD	4600.0	0.0	24	766.00	39.00	11.00
42249	SEELIGSON ZONE 14-B	4	GULF COAST BASIN	FRIO	SS	GCE+WD	5100.0	11.0	35	353.00	40.00	18.13
42249	SEELIGSON ZONE 16	4	GULF COAST BASIN	FRIO	SS	GCE	5700.0			214.00	40.00	11.00
42249	SEELIGSON ZONE 19-B	4	GULF COAST BASIN	FRIO	SS	GCE	6100.0	16.0	175	546.00	41.00	17.32
42249	SEELIGSON ZONE 19-C-4	4	GULF COAST BASIN	FRIO	SS	GCE	5900.0	25.0	212	585.00	43.00	80.00
42249	SEELIGSON ZONE 20-C	4	GULF COAST BASIN	FRIO	SS	GCE	6100.0		42	513.00	40.00	10.00
42131	SEVEN SISTERS G.W.	4	GULF COAST BASIN	GOVERNMENT WELLS	SS	SG+WD	2330.0	16.0	75	225.00	20.00	55.96

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42355	STRATTON BERTRAM WARDNER	4	GULF COAST BASIN	FRIO	SS	GCE	6500.0	23.0	200	220.00	43.00	18.60
42427	SUN FRIO D-1	4	GULF COAST BASIN	FRIO	SS	GCE	4300.0	13.0	109	549.00	45.00	26.12
42409	TAFT 4000	4	GULF COAST BASIN	CATAHOULA	SS	WD	4000.0	30.0	73	1500.00	23.00	25.28
42273	T.C.B. 21-B	4	GULF COAST BASIN	FRIO	SS	GCE	7100.0		117	186.00	40.00	45.00
42249	WADE CITY BIERSTADT	4	GULF COAST BASIN	FRIO	SS	WD	4800.0	12.0			29.00	10.08
42409	WHITE POINT E. BRIGHTON	4	GULF COAST BASIN	FRIO	SS	WD	5700.0	26.0	82	575.00	39.00	86.69
42489	WILLAMAR WILLAMAR	4	GULF COAST BASIN	WILLAMAR	SS	SG+GCE	7600.0	20.0	143	140.00	30.00	26.05
42489	WILLAMAR, W. W. WILLA.	4	GULF COAST BASIN	WILLAMAR	SS	SG+GCE	7900.0	34.0	160	65.00	31.00	53.20
42223	BRANTLEY JACKSON SMACK.	5	EAST TEXAS	SMACKOVER	DO,LS	SG	9200.0	50.0	240	25.00	40.00	15.62
42349	CHENEYBORO COTTON VAL.	5	EAST TEXAS	COTTON VALLEY	LS	SG	9700.0	15.0		12.00	50.00	2.00
42349	CORSICANA SHALLOW	5	EAST TEXAS	NAVARRO	SS	COMBINED	1200.0		84	28.00	36.00	43.44
42293	MEXIA WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	3000.0	40.0	110	1600.00	35.00	109.32
42223	PICKTON BACON LIME	5	EAST TEXAS	BACON LIME	LS	SG	7900.0	8.1	37	252.00	46.00	16.32
42349	POWELL WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2900.0	88.0	150	1600.00	36.00	131.40
42223	SULPHUR BLUFF PALUXY	5	EAST TEXAS	PALUXY	SS	WD	4500.0	60.0	150	4000.00	21.00	32.14
42467	VAN WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2700.0	250.0	700	1000.00	34.00	584.70
42161	WORTHAM WOODBINE	5	EAST TEXAS	WOODBINE	SS	WD	2900.0	24.0	50	1620.00	39.00	24.70
42001	FAIRWAY JAMES LIME	56	EAST TEXAS	JAMES LIME	LS	SG	10000.0	70.0	130	18.00	48.00	187.86
42365	BETHANY GLEN ROSE, 4300	6	EAST TEXAS	GLEN ROSE	LS	SG	4300.0	7.0		203.00	43.00	15.43
42365	BETHANY N.E. LIME, 3850	6	EAST TEXAS	GLEN ROSE	LS	SG	3900.0	9.0	30	28.00	43.00	13.95
42001	CAYUGA WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	4000.0	35.0	20	500.00	29.00	62.76
42499	COKE PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6300.0	50.0	131	1175.00	27.00	29.84
42499	HAWKINS WOODBINE	6	EAST TEXAS	WOODBINE	SS	COMBINED	4500.0	109.0	300	3394.00	24.00	814.21
42315	HAYNES MITCHELL	6	EAST TEXAS	MITCHELL	LS	SG	5900.0	18.0	140	25.00	40.00	13.42
42423	HITTS LAKE PALUXY	6	EAST TEXAS	PALUXY	SS	SG+WD	7200.0	32.0	130	400.00	26.00	13.61
42067	KILDARE RODESSA	6	EAST TEXAS	RODESSA	LS,SS	SG	6000.0	17.0	60	27.00	40.00	12.99
42001	LONG LAKE WOODBINE	6	EAST TEXAS	WOODBINE	SS	SG+PWD	5200.0	21.0	60	1085.00	40.00	36.49
42499	MANZIEL PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6300.0		165	830.00	32.00	21.93
42499	MERIGALE-PAUL SUB-CL.	6	EAST TEXAS	SUB-CLARKSVILLE	SS	SG	4800.0	0.0	235	300.00	30.00	11.25
42001	NECHES WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	4700.0	23.0	90	1020.00	40.00	98.84
42459	NEW DIANA WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	3700.0	11.0	75	141.00	40.00	11.43
42159	NEW HOPE BACON LIME	6	EAST TEXAS	BACON LIME	LS	SG+MWD	7400.0	11.0	120	379.00	44.00	15.45
42159	NEW HOPE PITTSBURG	6	EAST TEXAS	PITTSBURG	SS	SG+MWD	8000.0	14.0	367	61.00	46.00	20.14
42449	PEWITT RANCH PALUXY	6	EAST TEXAS	PALUXY	SS	WD	4300.0	29.0	78	2460.00	19.00	23.38
42063	PITTSBURG PITTSBURG	6	EAST TEXAS	PITTSBURG	SS	SG	8000.0	19.0	107	40.00	42.00	15.13

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42499	QUITMAN EAGLE FORD	6	EAST TEXAS	EAGLE FORD	SS	SG+WD	4200.0	35.0	200	115.00	25.00	10.65
42499	QUITMAN PALUXY	6	EAST TEXAS	PALUXY	SS	WD	6200.0	20.0	150	599.00	43.00	77.65
42067	RODESSA	6	EAST TEXAS	RODESSA	LS,SS	COMBINED	5700.0	20.0	80	61.00	43.00	67.00
42423	SAND FLAT PALUXY	6	EAST TEXAS	PALUXY	SS	SG	7000.0	30.0	251	277.00	29.00	33.24
42423	SHAMBURGER LAKE PALUXY	6	EAST TEXAS	PALUXY	SS	SG	7300.0	28.0	585	200.00	32.00	29.63
42449	TALCO PALUXY	6	EAST TEXAS	PALUXY	SS	WD	4300.0	44.0	200	2000.00	22.00	279.62
42401	EAST TEXAS WOODBINE	6	EAST TEXAS	WOODBINE	SS	WD	3600.0	35.0	324	1300.00	38.00	5041.24
42433	BOYD CONGL.	7B	PERMIAN BASIN	BEND CONGLOMERATE	CONGL	SG+PWD	6000.0	27.0	125	55.00	40.00	25.59
42429	BRECKENRIDGE POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3100.0	35.0	80	15.00	38.00	145.00
42151	CLAYTONVILLE CANYON	7B	PERMIAN BASIN	CANYON	LS	SG+PWD	5700.0	155.0	820	10.00	42.00	63.09
42417	COOK RANCH COOK	7B	BEND ARCH	COOK	SS	SG	1300.0	20.0		380.00	38.00	11.66
42429	CURRY POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3200.0	37.0	90	12.00	40.00	6.00
42429	ELIASVILLE POOL	7B	BEND ARCH	CADDO LIME	LS	SG	3300.0	27.0	90	8.00	39.00	28.00
42433	FLOWERS CANYON SAND	7B	PERMIAN BASIN	CANYON	SS	SG	4100.0	15.0		17.00	41.00	29.10
42253	GRIFFIN	7B	BEND ARCH	PALO PINTO LIME	LS	WD	3300.0	32.0	55		43.00	10.23
42253	HAMLIN EAST	7B	BEND ARCH	SWASTIKA	SS	SG+PWD	3200.0	25.0	55	350.00	39.00	13.99
42433	KATZ	7B	PERMIAN BASIN	STRAWN	SS	WD	4900.0	20.0	74	200.00	37.00	37.60
42433	KATZ 5100	7B	PERMIAN BASIN	STRAWN	SS	WD+SG	5100.0	35.0	90	56.00	37.00	16.92
42353	LAKE TRAMMELL W. CANYON	7B	PERMIAN BASIN	CANYON	SS	SG	5200.0	19.0	180	6.00	40.00	10.68
42353	NENA LUCIA STRAWN REEF	7B	PERMIAN BASIN	STRAWN	LS	SG+GCE	6900.0	52.0	230	5.00	46.00	33.67
42433	OLD GLORY	7B	PERMIAN BASIN	BEND CONGLOMERATE	CO,SS	SG+PWD	5900.0	17.0	120	49.00	40.00	12.51
42133	RANGER	7B	BEND ARCH	RANGER	SS,CO	SG	3400.0	26.0		162.00	37.00	65.78
42151	ROUGH DRAW NOODLE CREEK	7B	PERMIAN BASIN	NOODLE CREEK	LS	SG	3900.0	5.0	140	178.00	42.00	10.44
42151	ROUND TOP PALO PINTO	7B	PERMIAN BASIN	PALO PINTO LIME	LS	SG+WD	4800.0	90.0	475	6.00	40.00	48.68
42207	SOJOURNER	7B	PERMIAN BASIN	STRAWN	SS	SG	5300.0	19.0	115	15.00	41.00	10.14
42461	AMACKER-TIPPETT ELL.	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12100.0	285.0		23.00	53.00	17.59
42383	BARNHART ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	9000.0	75.0	397	7.00	47.00	16.17
42461	BENEDUM SPRABERRY	7C	PERMIAN BASIN	SPRABERRY	SS	SG	7600.0	33.0	250	0.50	36.00	23.57
42383	BIG LAKE	7C	PERMIAN BASIN	SAN ANDRES	DOLO	WD	3000.0	30.0	160	20.00	36.00	109.27
42383	BIG LAKE ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8300.0		282		42.00	21.17
42383	CALVIN DEAN	7C	PERMIAN BASIN	DEAN	SS	SG	7400.0	35.0		1.00	41.00	40.98
42431	COPE	7C	PERMIAN BASIN	SPRABERRY	SS	SG	5100.0	23.0		24.00	35.00	12.12
42399	CREE-SYKES GARDNER	7C	BEND ARCH	GARDNER	SS	SG	4000.0	19.0		111.00	41.00	15.47
42105	ELKHORN ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD+SG	7200.0	121.0	455	34.00	39.00	11.75

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42105	FARMER	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	2200.0	75.0	70	4.00	30.00	18.38
42399	FORT CHADBOURNE	7C	PERMIAN BASIN	STRAWN	LS	SG+PGCE	5400.0	44.0	240	28.00	45.00	53.25
42451	H-J STRAWN	7C	PERMIAN BASIN	STRAWN	LS	SG+PWD	5500.0	50.0	200	100.00	42.00	23.20
42413	HULLDALE PENN. REEF	7C	PERMIAN BASIN	PENNSYLVANIAN REEF	LS	GCE+PWD	5800.0	39.0	87	43.00	40.00	26.55
42081	I.A.B. MENIELLE PENN.	7C	PERMIAN BASIN	MENIELLE	LS	SG	5800.0	75.0	435	27.00	44.00	21.50
42081	JAMESON	7C	PERMIAN BASIN	CISCO SAND	SS	SG	6300.0	40.0	700	2.00	49.00	44.85
42081	JAMESON REEF	7C	PERMIAN BASIN	STRAWN	LS	GCE+SG	6400.0	71.0	405	2.00	43.00	41.41
42461	MCCAMEY	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	SG+PWD	2200.0	75.0	260	18.00	28.00	132.84
42413	NEVA WEST STRAWN	7C	PERMIAN BASIN	STRAWN	LS	GCE	6200.0	80.0	166	8.00	46.00	13.90
42105	OLSON	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	1800.0	40.0	200	28.00	25.00	14.04
42461	PEGASUS ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	GD	13000.0	28.0	829		53.00	92.32
42461	PEGASUS PENN.	7C	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	10500.0	0.0	567	9.00	44.00	15.44
42461	PEGASUS SPRABERRY	7C	PERMIAN BASIN	SPRABERRY	SS	SG	8300.0	30.0	160	0.10	37.00	13.76
42105	SHANNON SAN ANDRES	7C	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2400.0	35.0	170	24.00	26.00	11.62
42329	SPRABERRY TREND	7C	PERMIAN BASIN	SPRABERRY	SS	SG	6800.0	25.0		0.30	39.00	457.00
42451	SUSAN PEAK	7C	PERMIAN BASIN	STRAWN	LS	WD	4700.0	43.0	113	40.00	37.00	14.64
42105	TODD DEEP CRINOIDAL	7C	PERMIAN BASIN	CRINOIDAL	LS	SG+PWD	5800.0	115.0	450	14.00	41.00	36.47
42105	TODD DEEP ELL.	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD+SG	6000.0	155.0		5.00	42.00	43.97
42105	VAUGHN	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+GCE	1500.0	30.0	80	10.00	28.00	12.31
42461	WILSHIRE ELLENBURGER	7C	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12200.0	212.0	616	15.00	53.00	40.86
42105	WORLD	7C	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	WD	2600.0	50.0		8.00	27.00	43.35
42371	ABELL SIL.-MONTOYA	8	PERMIAN BASIN	MONTOYA	DO,CH	SG	5000.0	45.0	272		40.00	12.62
42135	ANDECTOR ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8500.0	410.0	817	300.00	44.00	173.28
42003	ANDREWS	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	9200.0	0.0	300	31.00	40.00	14.29
42003	ANDREWS NORTH ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12400.0	135.0		50.00	45.00	28.54
42003	ANDREWS SOUTH DEV.	8	PERMIAN BASIN	DEVONIAN	LS,DO	SG	10900.0			2.00	47.00	10.20
42003	ANDREWS S. WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	9100.0	34.0	200	11.00	40.00	14.23
42003	ANDREWS WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8600.0	25.0	250	18.00	38.00	20.80
42371	APCO-WARNER ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	4600.0	150.0	300	0.00	40.00	12.32
42495	ARENOSA STRAWN DETRITUS	8	PERMIAN BASIN	STRAWN	CH	SG	8500.0	24.0	600	73.00	38.00	21.12

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42003	BAKKE	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	8900.0	23.0	500	13.00	40.00	12.14
42003	BAKKE DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	10500.0		150	903.00	47.00	16.45
42003	BAKKE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12400.0	122.0		47.00	43.00	23.71
42003	BAKKE WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8500.0	35.0	200	38.00	41.00	22.34
42003	BEDFORD DEVONIAN	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG+PWD	8800.0	100.0	540	5.00	41.00	16.26
42317	BREEDLOVE SIL.-DEV.	8	PERMIAN BASIN	SILURO-DEVONIAN	DO,LS	WD	12100.0	45.0	145	50.00	41.00	28.97
42103	C-BAR	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	3500.0	35.0	100	5.00	33.00	18.83
42103	CORDONA LAKE DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	5400.0	60.0	235	15.00	40.00	25.93
42135	COWDEN NORTH	8	PERMIAN BASIN	GRAYBURG	DO,SS	SG+GCE	4300.0	125.0	800	7.00	35.00	437.07
42135	COWDEN NORTH DEEP	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5100.0	40.0	100	7.00	37.00	52.17
42135	COWDEN SOUTH	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	4600.0	56.0	800	3.00	35.00	147.40
42135	COWDEN S. 8790 CANYON	8	PERMIAN BASIN	CANYON LIME	LS	SG+LGCE	8800.0	65.0	300	4.00	40.00	33.88
42103	CROSSETT DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	5400.0	88.0	260	6.00	44.00	19.80
42461	CROSSETT SOUTH DEV.	8	PERMIAN BASIN	DEVONIAN	DO,CH	SG	5600.0	80.0	500	3.00	42.00	17.15
42003	DEEP ROCK ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12300.0	146.0		10.00	44.00	14.01
42003	DOLLARHIDE CLEAR FORK	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6500.0	40.0	350	10.00	38.00	35.97
42003	DOLLARHIDE DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,CH	SG	8000.0	70.0	1000	17.00	40.00	81.25
42003	DOLLARHIDE ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10000.0	187.0		5.00	41.00	25.69
42003	DOLLARHIDE SILURIAN	8	PERMIAN BASIN	SILURIAN	DO,LS	WD	8500.0	194.0	520	9.00	42.00	38.83
42135	DORA ROBERTS ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+WD	13000.0	212.0		280.00	51.00	50.02
42103	DUNE	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	3300.0	80.0	800	6.00	34.00	176.00
42135	EDWARDS WEST CANYON	8	PERMIAN BASIN	CANYON LIME	LS	SG+LWD	8700.0	80.0	300	5.00	41.00	22.77
42301	EL MAR DELAWARE	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4500.0	15.0		14.00	41.00	17.84
42003	EMBAR ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	7700.0	195.0	380	40.00	45.00	22.34
42003	EMMA	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4000.0	58.0	183	11.00	33.00	20.09
42003	EMMA ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12300.0	290.0	183	54.00	49.00	53.73
42495	EMPEROR DEEP	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2900.0	61.0	350	20.00	33.00	11.18
42371	FORT STOCKTON	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS	SG+LGCE	2800.0	38.0	450	35.00	32.00	30.89
42135	FOSTER	8	PERMIAN BASIN	GRAYBURG	DOLO	SG	4300.0	110.0	800	7.00	35.00	256.88
42003	FUHRMAN-MASCHO	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+WD	4300.0	72.0	295	5.00	32.00	104.48
42003	FULLERTON	8	PERMIAN BASIN	CLEAR FORK	DO,LS	SG	7000.0		500	3.00	42.00	262.21
42003	FULLERTON 8500 DEV.	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	8500.0	40.0	350	50.00	45.00	46.02
42003	FULLERTON SOUTH ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10700.0	275.0		77.00	44.00	11.82

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42389	GERALDINE-FORD	8	PERMIAN BASIN	CHERRY CANYON	SS	SG	2600.0	28.0	400	49.00	41.00	21.73
42003	GLASCO DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	12600.0	67.0	150	200.00	37.00	19.99
42135	GOLDSMITH	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	4100.0	48.0	300	12.00	36.00	345.85
42135	GOLDSMITH 5600	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5600.0	50.0	400	25.00	38.00	223.85
42135	GOLDSMITH CLEAR FORK	8	PERMIAN BASIN	CLEAR FORK	DO,LS	SG	6100.0	70.0	200	5.00	40.00	73.30
42135	GOLDSMITH DEVONIAN	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG+PWD	8000.0	45.0	150	47.00	40.00	13.93
42135	GOLDSMITH NORTH	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4400.0	35.0	200	2.00	35.00	16.46
42495	HALLEY	8	PERMIAN BASIN	YATES-SEVEN RIVERS	SS,DO	COMBINED	2700.0	45.0	300	20.00	34.00	42.43
42135	HARPER	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	4100.0	50.0	400	2.00	36.00	45.55
42135	HARPER ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DO,LS	SG+WD	12300.0	225.0		2.00	46.00	22.46
42135	HEADLEE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	13300.0	325.0	393	40.00	51.00	37.68
42495	HENDERSON	8	PERMIAN BASIN	UPPER GUADALUPIAN	DO,SS	SG+LWD	3100.0	40.0	200	50.00	31.00	15.88
42495	HENDRICK	8	PERMIAN BASIN	UPPER GUADALUPIAN REEF	SS,DO	WD	2500.0	100.0	750	7.00	28.00	260.45
42227	HOWARD-GLASSCOCK GLOR.	8	PERMIAN BASIN	GLORIETA	LS,DO	SG+WD	3200.0	60.0		4.00	27.00	87.20
42227	HOWARD-GLASSCOCK PERM.	8	PERMIAN BASIN	PERMIAN LIME	DO,SS	SG	1500.0	147.0		25.00	32.00	310.64
42003	HUTEX DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,LS	WD	12500.0	60.0	270	44.00	44.00	44.31
42227	IATAN-EAST HOWARD	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	SG+PWD	2700.0	65.0	500	10.00	30.00	143.08
42003	INEZ ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12500.0	50.0		9.00	50.00	16.40
42135	JOHNSON	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,LS	SG	4100.0		200	5.00	35.00	29.96
42103	JORDAN	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3500.0		300	20.00	35.00	84.62
42135	JORDAN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8800.0			300.00	45.00	31.11
42495	KERMIT	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2800.0	22.0	600	14.00	34.00	107.91
42495	KEYSTONE COLBY	8	PERMIAN BASIN	COLBY	SS,DO	SG	3100.0	900.0	550	3.00	38.00	71.70
42495	KEYSTONE DEV.	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG+PGCE	7900.0	60.0	1100	8.00	37.00	15.34
42495	KEYSTONE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD+PGCE	9600.0	300.0	585	5.00	44.00	144.90
42495	KEYSTONE HOLT	8	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4800.0	55.0	55	58.00	40.00	39.70
42495	KEYSTONE SIL.	8	PERMIAN BASIN	SILURIAN LIME	DO,LS	SG	8400.0	113.0	1200	3.00	39.00	28.88
42135	LAWSON	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+PWD	4300.0	36.0	100	6.00	37.00	15.33
42103	LEA ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8200.0	202.0	430	300.00	43.00	20.11

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42003	LOWE ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	13300.0	120.0		31.00	54.00	11.61
42003	LOWE SILURIAN	8	PERMIAN BASIN	SILURIAN	DOLO	SG	12800.0	50.0	150	7.00	49.00	14.41
42227	LUTHER S.E. SIL.-DEV.	8	PERMIAN BASIN	SILURO-DEVONIAN	DOLO	SG	9900.0	65.0	125	16.00	44.00	23.89
42003	MABEE	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4700.0	40.0	150	8.00	32.00	89.56
42003	MABEE	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4700.0	40.0	150	8.00	32.00	89.56
42003	MAGUTEX DEVONIAN	8	PERMIAN BASIN	DEVONIAN	DO,LS	WD	12500.0		150	83.00	43.00	45.43
42003	MAGUTEX ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	LS,DO	WD	13800.0	70.0	160	16.00	46.00	17.23
42003	MARTIN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8800.0	278.0	545	369.00	43.00	36.40
42103	MCELROY	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	2900.0	86.0	1400	50.00	32.00	483.43
42003	MCFARLAND	8	PERMIAN BASIN	QUEEN	SS,DO	SG	4800.0	17.0	325	12.00	34.00	38.60
42003	MEANS 1	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DO,SS	WD+GCE	4400.0	135.0	230	20.00	31.00	180.36
42003	MEANS 2	8	PERMIAN BASIN	QUEEN	SS	SG	4100.0	7.0	250	40.00	33.00	37.56
42003	MIDLAND FARMS	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+PWD	4800.0	100.0	250	61.00	32.00	144.62
42003	MIDLAND FARMS ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	12600.0		525	9.00	48.00	50.01
42003	MIDLAND FARMS NORTH	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG+PWD	4800.0	51.0	200	6.00	29.00	15.68
42003	MIDLAND FARMS WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	20.0	300	30.00	41.00	13.65
42003	NOLLEY WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS,DO	SG+PWD	9100.0	60.0	400	20.00	37.00	26.84
42227	OCEANIC	8	PERMIAN BASIN	PENNSYLVANIAN REEF	LS	WD	8100.0	60.0	215	84.00	42.00	22.71
42371	PAYTON	8	PERMIAN BASIN	YATES	SS	SG	2000.0	20.0		35.00	36.00	13.00
42371	PECOS VALLEY HI GRAV.	8	PERMIAN BASIN	YATES	SS	SG	1700.0	16.0	400	45.00	31.00	19.05
42135	PENWELL	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3600.0		400	3.00	33.00	83.23
42135	PENWELL ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	8900.0	85.0			43.00	13.91
42103	RUNNING W WADDELL	8	PERMIAN BASIN	WADDELL	SS	SG+GCE	6100.0	22.0	350	164.00	38.00	23.73
42103	SAND HILLS MCKNIGHT	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	3500.0	150.0	500	1.00	33.00	115.40
42103	SAND HILLS ORD.	8	PERMIAN BASIN	ORDOVICIAN	DOLO	WD	5900.0	20.0	30	0.00	37.00	12.66
42103	SAND HILLS TUBB	8	PERMIAN BASIN	TUBB	DOLO	SG+PGCE	4500.0	47.0	250	30.00	35.00	90.41
42495	SCARBOROUGH	8	PERMIAN BASIN	YATES	SS	SG+LWD	3000.0	55.0	450	12.00	37.00	36.68
42003	SHAFTER LAKE DEV.	8	PERMIAN BASIN	DEVONIAN	LS	SG+PGD	9500.0	140.0	710	6.00	38.00	24.48
42003	SHAFTER LAKE SAN AND.	8	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4400.0	37.0	400	5.00	34.00	42.80
42003	SHAFTER LAKE WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	18.0	235	28.00	42.00	12.16
42475	SHIPLEY	8	PERMIAN BASIN	QUEEN	SS,DO	SG+PWD	2400.0	0.0	150	22.00	35.00	28.44

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42227	SNYDER	8	PERMIAN BASIN	SAN ANGELO	DOLO	SG	2600.0	50.0		1.00	30.00	38.73
42371	TAYLOR-LINK	8	PERMIAN BASIN	SAN ANDRES	SS,LS	SG+WD	1300.0	35.0	90	40.00	32.00	15.30
42003	THREE BAR DEV.	8	PERMIAN BASIN	DEVONIAN	CH,LS	SG	8400.0		375	54.00	40.00	39.04
42371	TOBORG CRETACEOUS	8	PERMIAN BASIN	CRETACEOUS	SS	SG	500.0			86.00	22.00	41.23
42003	TRIPLE-N PENN.	8	PERMIAN BASIN	UPPER PENNSYLVANIAN LIME	LS	SG	8900.0		300	7.00	40.00	15.43
42389	TUNSTILL	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	3300.0	12.0	215	30.00	40.00	11.51
42301	TWOFREDS DELAWARE	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4900.0	21.0	210	33.00	35.00	12.72
42135	TXL DEV.	8	PERMIAN BASIN	DEVONIAN	CH	SG	8000.0		600	100.00	40.00	43.51
42135	TXL ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	9600.0	240.0	660	39.00	44.00	128.30
42135	TXL TUBB	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6200.0		450	1.00	35.00	43.04
42003	UNION	8	PERMIAN BASIN	LOWER CLEAR FORK	DOLO	SG	6900.0	55.0	200	2.00	33.00	15.90
42103	UNIV. BLOCK 31 DEVONIAN	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	8500.0	130.0	610	0.70	40.00	206.62
42003	UNIV. BLOCK 9 DEV.	8	PERMIAN BASIN	DEVONIAN	DOLO	WD	10500.0	107.0	400	3.00	45.00	20.07
42003	UNIV. BLOCK 9 PENN.	8	PERMIAN BASIN	PENNSYLVANIAN LIME	LS	SG	9000.0	35.0	250	11.00	40.00	12.66
42003	UNIV. BLOCK 9 WOLFCAMP	8	PERMIAN BASIN	WOLFCAMP LIME	LS	SG	8400.0	40.0	250	14.00	38.00	25.62
42103	UNIV. WADDELL DEV.	8	PERMIAN BASIN	DEVONIAN	LS,CH	SG	8600.0		900	1.00	40.00	61.07
42227	VEALMOOR	8	PERMIAN BASIN	CANYON REEF	LS	WD	7800.0	95.0	200	32.00	46.00	37.52
42033	VEALMOOR EAST	8	PERMIAN BASIN	CANYON REEF	LS	WD	7400.0	107.0	610	38.00	48.00	59.98
42329	VIREY ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+WD	13100.0	153.0	0	32.00	51.00	30.08
42103	WADDELL	8	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	3500.0	100.0	300	12.00	34.00	99.33
42475	WARD SOUTH	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	SG	2400.0	18.0	350	40.00	35.00	104.13
42475	WARD-ESTES NORTH	8	PERMIAN BASIN	UPPER GUADALUPIAN	SS,DO	COMBINED	2500.0	30.0	600	40.00	38.00	366.69
42329	WAR-SAN ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	SG+PWD	13100.0	150.0		51.00	49.00	14.27
42335	WESTBROOK	8	PERMIAN BASIN	CLEAR FORK	DOLO	SG	2900.0	45.0	250	5.00	24.00	90.74
42301	WHEAT	8	PERMIAN BASIN	DELAWARE SAND	SS	SG	4300.0	17.0	230	19.00	36.00	21.80
42495	WHEELER ELLENBURGER	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10500.0	88.0	342	54.00	44.00	17.85
42135	YAR. AND ALLEN ELL.	8	PERMIAN BASIN	ELLENBURGER	DOLO	WD	10500.0	24.0		28.00	41.00	40.13
42371	YATES PERM. GUAD.	8	PERMIAN BASIN	PERMIAN GUADALUPIAN	DO,LS	GD+GCE	1250.0	120.0	486	118.00	30.00	1180.07
42317	ACKERLY DEAN	8A	PERMIAN BASIN	DEAN	SS	SG	8200.0	35.0	500	0.40	38.00	33.35
42445	ADAIR	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4800.0	60.0	140	4.00	34.00	56.61

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42445	ADAIR WOLFCAMP	8A	PERMIAN BASIN	WOLFCAMP	LS	SG	8500.0	68.0	215	28.00	43.00	51.48
42165	AMROW DEVONIAN	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	12600.0	131.0	159	34.00	35.00	14.89
42279	ANTON-IRISH	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5300.0	141.0	700	9.00	31.00	175.24
42501	BRAHANEY	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5200.0	35.0	179	2.00	32.00	43.00
42501	BRONCO SIL.-DEV.	8A	PERMIAN BASIN	SILURO-DEVONIAN	DOLO	WD	11800.0	160.0	265	150.00	44.00	13.97
42165	CEDAR LAKE	8A	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4800.0	50.0	250	12.00	33.00	78.60
42263	CLAIREMONT	8A	PERMIAN BASIN	LOWER PENNSYLVANIAN	LS	WD	6700.0	20.0	47	21.00	39.00	15.27
42263	COGDELL	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6800.0	73.0	770	18.00	42.00	256.48
42415	DIAMOND M	8A	PERMIAN BASIN	CANYON REEF	LS	SG+PWD	6600.0	80.0	440	72.00	44.00	237.59
42169	DORWARD	8A	PERMIAN BASIN	SAN ANGELO	DOLO	SG	2400.0	45.0	100	3.00	38.00	18.25
42165	FLANAGAN U. CLFK.	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6300.0	45.0	750	3.00	32.00	20.85
42415	FLUVANNA STRAWN	8A	PERMIAN BASIN	STRAWN	LS	SG+PWD	7800.0	42.0	300	93.00	40.00	13.63
42169	GARZA	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2500.0	55.0	300	8.00	35.00	95.01
42033	GOOD	8A	PERMIAN BASIN	CANYON REEF	LS	WD	8000.0	246.0	489	52.00	44.00	47.11
42165	HARRIS	8A	GULF COAST BASIN	GLORIETA	DO,SS	SG	5900.0	55.0		11.00	31.00	61.46
42033	HOBO	8A	PERMIAN BASIN	CISCO REEF	LS	WD	7100.0	39.0	100	32.00	46.00	12.17
42033	JO-MILL SPRABERRY	8A	PERMIAN BASIN	SPRABERRY	SS	SG	7100.0	19.4		3.00	39.00	81.94
42415	KELLY-SNYDER	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6700.0	137.0	700	19.00	42.00	1210.99
42415	KELLY-SNYDER CISCO SAND	8A	PERMIAN BASIN	CISCO SAND	SS	SG	6100.0	20.0	120	42.00	42.00	15.18
42445	KINGDOM ABO	8A	PERMIAN BASIN	ABO	DOLO	SG	7800.0	70.0	400	5.00	30.00	42.12
42079	LEVELLAND	8A	PERMIAN BASIN	SAN ANDRES	DO,LS	SG	4900.0	50.0		2.00	30.00	493.32
42501	OWNBY	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6900.0	47.0	165	4.00	31.00	15.89
42501	PRENTICE	8A	PERMIAN BASIN	GLORIETA	DOLO	SG	6000.0	52.0	180	12.00	28.00	47.55
42501	PRENTICE 6700	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6700.0	85.0	270	2.00	28.00	112.39
42501	REEVES	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5600.0	45.0	180	3.00	32.00	25.60
42033	REINECKE	8A	PERMIAN BASIN	CISCO REEF	LS	SG+PWD	6800.0	65.0	304	22.00	46.00	78.17
42415	REVILO GLORIETA	8A	PERMIAN BASIN	GLORIETA	DOLO	SG	2700.0	28.0		3.00	35.00	12.98
42165	RILEY N. U. CLFK.	8A	PERMIAN BASIN	UPPER CLEAR FORK	DOLO	SG	6300.0	70.0	60	12.00	32.00	26.90
42165	ROBERTSON N. CLFK.	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	7100.0	35.0	200	19.00	35.00	122.83
42165	RUSSELL 7000 CLFK.	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	7000.0	95.0	700	2.00	35.00	53.57
42165	RUSSELL NORTH DEV.	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	11200.0	65.0	500	141.00	41.00	77.05
42263	SALT CREEK	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6300.0	100.0	726	10.00	40.00	260.91

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42165	SEMINOLE	8A	PERMIAN BASIN	SAN ANDRES	DOLO	GCE+SG	5200.0	87.0	262	25.00	35.00	458.19
42165	SEMINOLE WEST	8A	PERMIAN BASIN	SAN ANDRES	DOLO	GCE,SG	5100.0	180.0	140	9.00	34.00	31.90
42415	SHARON RIDGE 1700	8A	PERMIAN BASIN	GRAYBURG-SAN ANDRES	DOLO	SG	1700.0	35.0		3.00	28.00	55.89
42415	SHARON RIDGE 2400	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	2400.0	95.0	150	8.00	32.00	20.20
42079	SLAUGHTER	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	5000.0	48.0		11.00	30.00	857.50
42263	S-M-S CANYON SAND	8A	PERMIAN BASIN	CANYON	SS	SG	6100.0	17.0	63	117.00	38.00	11.22
42219	SMYER	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	5900.0	30.0	200	8.00	26.00	39.45
42115	TEX-HAMON FUSSELMAN	8A	PERMIAN BASIN	FUSSELMAN	DO,CH	WD	11600.0	65.0	167	25.00	40.00	16.21
42033	VON ROEDER AND N.V.R	8A	PERMIAN BASIN	CANYON REEF	LS	SG	6800.0	45.0	155	13.00	43.00	30.04
42501	WASSON	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG+GCE	4900.0	275.0	330	4.00	33.00	1573.83
42501	WASSON 6600 AND 7200	8A	PERMIAN BASIN	CLEAR FORK	DOLO	SG	6900.0	135.0	400	10.00	33.00	107.59
42501	WASSON N.E.	8A	PERMIAN BASIN	LOWER CLEAR FORK	DOLO	SG	7800.0	72.0	400	9.00	30.00	13.72
42115	WELCH	8A	PERMIAN BASIN	SAN ANDRES	DOLO	SG	4900.0	100.0	180	9.00	33.00	141.79
42445	WELLMAN	8A	PERMIAN BASIN	WOLFCAMP REEF	DOLO	SG+PWD	9300.0	338.0	800	100.00	43.00	68.04
42501	WEST DEVONIAN	8A	PERMIAN BASIN	DEVONIAN	DOLO	WD	11100.0	40.0	200	9.00	40.00	22.32
42077	ANTELOPE M1	9	FORT WORTH SYNCLINE	STRAWN	SS	SG+WD	3200.0	18.0	65	133.00	43.00	13.76
42181	BIG MINERAL CRK. BARNES	9	SOUTH OKLAHOMA BASIN	BARNES	SS	SG	5300.0	54.0	300	59.00	37.00	21.08
42237	BRYSON EAST	9	FORT WORTH SYNCLINE	STRAWN	SS	SG	3100.0	20.0		60.00	40.00	14.02
42487	FARGO 3900	9	PALO DURO BASIN (TEXAS 8A)	CANYON	SS	SG	3900.0	22.0	110	100.00	41.00	12.39
42487	FARGO 4200	9	PALO DURO BASIN (TEXAS 8A)	CANYON	SS	SG	4200.0	24.0	215	10.00	40.00	12.70
42097	GATEWOOD	9	PERMIAN BASIN	STRAWN	SS	SG+LWD	1600.0	20.0		148.00	33.00	11.14
42337	HILDRETH	9	FORT WORTH SYNCLINE	BEND	CONGL	SG+PWD	7500.0	15.0	100	257.00	41.00	22.55
42009	HULL-SILK-SIKES 3800	9	BEND ARCH	STRAWN	SS	SG	3800.0	26.0	100	180.00	39.00	20.90
42009	HULL-SILK-SIKES 4300	9	BEND ARCH	STRAWN	SS	SG	4300.0		125	61.00	41.00	50.59
42077	JOY STRAWN	9	FORT WORTH SYNCLINE	STRAWN	SS	SG	4400.0	14.0	150	40.00	41.00	18.40
42485	KMA	9	PALO DURO BASIN (TEXAS 8A)	STRAWN	SS,LS	SG	3700.0	24.0		55.00	40.00	174.27
42275	KNOX CITY NORTH CANYON	9	PERMIAN BASIN	CANYON	LS	SG+PWD	4200.0		155	13.00	40.00	15.25

Table A1. Texas Reservoir Database (Continued)

CNTY CODE	FIELD_RES	RRC DIST	PROVINCE	PRODUCING FORMATION	LITH	DRIVE	DEPTH	NET PAY	OIL COLUMN	AVG. PERM	API	CUMULATIVE PRODUCTION
42155	RASBERRY 6100	9	PALO DURO BASIN (TEXAS 8A)	CADDO LIME	LS	SG	6100.0	47.0	174	3.00	41.00	12.37
42237	RUSMAG	9	BEND ARCH	CADDO CONGLOMERATE	CONGL	SG+GCE	4600.0	22.0	175	19.00	41.00	15.62
42181	SADLER PENN.	9	SOUTH OKLAHOMA FOLDED BELT	PENNSYLVANIAN	SS	SG	6700.0	25.0	400	28.00	34.00	17.60
42181	SANDUSKY OIL CREEK	9	SOUTH OKLAHOMA FOLDED BELT	SIMPSON	SS	SG+PWD	7200.0	33.0	80	238.00	42.00	14.84
42097	SIVELLS BEND	9	SOUTH OKLAHOMA FOLDED BELT	STRAWN	SS	SG	6600.0	46.0		126.00	42.00	30.35
42097	WALNUT BEND HUDSPETH	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+LWD	3900.0	40.0	100	138.00	40.00	21.50
42097	WALNUT BEND REGULAR	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+WD	4900.0	50.0	300	176.00	36.00	46.34
42097	WALNUT BEND WINGER	9	SOUTH OKLAHOMA BASIN	STRAWN	SS	SG+PWD	5500.0	21.0	300	309.00	32.00	27.74
42237	WORSHAM-STEED BEND	9	FORT WORTH SYNCLINE	BEND CONGLOMERATE	CO,SS	SG+GCE	4700.0	18.0	210	50.00	41.00	10.87

Appendix B

API County Codes

Appendix B

API County Codes

County Code	County	County Code	County
42001	Anderson	42247	Jim Hogg
42003	Andrews	42249	Jim Wells
42007	Aransas	42253	Jones
42009	Archer	42255	Karnes
42013	Atascosa	42263	Kent
42015	Austin	42273	Kleberg
42025	Bee	42275	Knox
42033	Borden	42279	Lamb
42039	Brazoria	42287	Lee
42041	Brazos	42291	Liberty
42055	Caldwell	42293	Limestone
42057	Calhoun	42301	Loving
42063	Camp	42315	Marion
42065	Carson	42317	Martin
42067	Cass	42321	Matagorda
42071	Chambers	42323	Maverick
42077	Clay	42329	Midland
42079	Cochran	42335	Mitchell
42081	Coke	42337	Montague
42097	Cooke	42339	Montgomery
42103	Crane	42349	Navarro
42105	Crockett	42353	Nolan
42115	Dawson	42355	Nueces
42123	Dewitt	42357	Ochiltree
42127	Dimmit	42365	Panola
42131	Duval	42371	Pecos
42133	Eastland	42373	Polk
42135	Ector	42383	Reagan
42151	Fisher	42389	Reeves
42155	Foard	42391	Refugio
42157	Fort Bend	42399	Runnels
42159	Franklin	42401	Rusk
42161	Freestone	42407	San Jacinto
42163	Frio	42409	San Patricio
42165	Gaines	42413	Schleicher
42167	Galveston	42415	Scurry
42169	Garza	42417	Shackelford
42175	Goliad	42423	Smith
42181	Grayson	42427	Starr
42187	Guadalupe	42429	Stephens
42199	Hardin	42431	Sterling
42201	Harris	42433	Stonewall
42207	Haskell	42445	Terry
42219	Hockley	42449	Titus
42223	Hopkins	42451	Tom Green
42227	Howard	42459	Upshur
42237	Jack	42461	Upton
42239	Jackson	42467	Van Zandt
42245	Jefferson	42469	Victoria

County Code	County
42473	Waller
42475	Ward
42479	Webb
42481	Wharton
42485	Wichita
42487	Wilbarger
42489	Willacy
42495	Winkler
42499	Wood
42501	Yoakum
42505	Zapata

Appendix C

FORTRAN Code Used for Screening

Appendix C

FORTRAN Code Used for Screening

```
$DEBUG
* PROGRAM TO RANK RESERVOIRS FOR CO2 MISCIBLE DISPLACEMENT
      DIMENSION RES(550,13)
      INTEGER I,J,M,N1,K,N2
* "REMEMBER PUT RESERVOIR NUMBER (including optimum)(N1) PLUS ONE IN N2"
      PARAMETER (M = 8, N2 = 377)
      REAL OPTM(M),WRTL(M),WRTR(m),WFAC(m),WORST(m),
     & WT(m,n2),A(n2,m),X(n2,m),SUM3(n2),R(n2),NWELL(N2),
     & W(n2,m),V(n2,n2),TEMP,OPRIC,SPAC,SPACE,NW(N2),
     & COSNW,COSEQP,PIPCAP,COSPIP,SPRC,OPCOS,CO2COS,
     & TOTCOS,NREV,RATRC(n2),SMALL,PERCENT(15),CO2,RF,
     & IRATE, YEAR, BTNPV, PCOST, YREV
      N1=N2-1
      OPEN (5,FILE='INPUTdb.DAT')
      READ (5,*) (OPTM(J),J=1,8)
      READ (5,*) (WRTR(J),J=1,8)
      READ (5,*) (WFAC(J),J=1,8)
      READ (5,*) (PERCENT(J),J=1,15)
      READ (5,*) ((RES(I,J),J=1,13),I=1,N1)
      CLOSE (5)
      OPEN (6,FILE='OUTPUTdb.DAT')
* CALCULATION OF WRTL & WORST FICTICIOUS RESERVOIR
      DO 7 J=1,8
      SMALL=1E20
      DO 8 I=2,N1
      SMALL=MIN(SMALL,RES(I,J))
 8    CONTINUE
      WRTL(J)=SMALL
      RES(N2,J)=SMALL
 7    CONTINUE
* SELECTION OF WORST PARAMETER
      DO 5,I=1,N2
      DO 10,J=1,8
      IF(RES(I,J) .GT. WRTR(J)) THEN
      RES(I,J)=WRTR(J)
      ELSE
      ENDIF
      IF(RES(I,J) .LE. OPTM(J)) THEN
        WORST(J)=WRTL(J)
```

```
      ELSE
       WORST(J)=WRTR(J)
      ENDIF
* CALCULATION OF NORMALIZED PARAMETER
      TEMP=ABS(WORST(J)-OPTM(J))
      X(I,J)=(ABS(RES(I,J)-OPTM(J))/ABS(WORST(J)-OPTM(J)))
* CALCULATION OF EXPONENTIAL FUNCTION
      A(I,J)=100*EXP(-4.6*(X(I,J)**2))
* CALCULATION OF THE WEIGTHED MATRIX
      W(I,J)=A(I,J)*WFAC(J)
 10   CONTINUE
 5    CONTINUE
* CALCULATION OF THE TRANSPOSED WEIGTHED MATRIX
      DO15,I=1,N2
      DO20,J=1,8
      WT(J,I)=W(I,J)
 20   CONTINUE
 15   CONTINUE
* CALCULATION OF THE PRODUCT MATRIX
      DO25,I=1,N2
      DO30,K=1,N2
      SUM1=0
      DO40,J=1,8
      SUM1=SUM1+W(I,J)*WT(J,K)
 40   CONTINUE
      V(I,K)=SUM1
 30   CONTINUE
 25   CONTINUE
* CALCULATION OF OPTIMUM CHARACTERISTIC PARAMETER
      I=1
      SUM2=0
      DO80,J=1,N2
      SUM2=SUM2+V(I,J)
 80   CONTINUE
      RO=SUM2
* CALCULATION OF THE CHARACTERISTIC PARAMETERS
      DO90,I=1,N2
      SUM3(I)=0
      DO100,J=1,N2
      SUM3(I)=SUM3(I)+V(I,J)
 100  CONTINUE
      R(I)=(100*SUM3(I))/RO
 90   CONTINUE
* END OF TECHNICAL RANKING - BEGINNING ECONOMIC RANKING
      PRINT *,'TECHNICAL SCREENING READY'
      PRINT *,'CONTINUE WITH ECONOMICAL SCREENING? YES=1, NO=0'
```

```
      READ *,EE
      IF (EE.EQ.0) THEN
      PRINT 1010,(R(I),I=1,N2)
      WRITE (6,1010)(R(I),I=1,N2)
      GO TO 120
      ELSE
      CONTINUE
      ENDIF
* ECONOMICAL EVALUATION
 105  PRINT *,'DISCOUNT RATE (fraction)=?'
      READ *,IRATE
      PRINT *,'OIL PRICE ($/Bbl)=?'
      READ *,OPRIC
      PRINT *,'RECOVERY FACTOR (fraction)=?'
      READ *,RF
      PRINT *,'SPACE (acres/well)=?'
      READ *,SPACE
      PRINT *,'CO2 COST ($/MSCF)=?'
      READ *,CO2
* CAPITAL COSTS
* 1.DRILLING
      DO 110,I=2,N1
      IF (RES(I,11).NE.0) SPAC = RES(I,10)/RES(I,11)
      IF (RES(I,11).EQ.0) NW(I)=RES(I,10)/SPACE
      IF (SPAC.LE.SPACE) NW(I)=0
      IF (SPAC.GT.SPACE) NW(I) = (RES(I,10)/SPACE)-RES(I,11)
      IF (RES(I,10).LE.60) NW(I) = 2
      NWELL(I) = NINT(NW(I))
      COSNW=30430*EXP(0.00035*RES(I,12))*NWELL(I)
* 2.EQUIPMENT
      COSEQP=8.3125*RES(I,12)*(RES(I,11)+NWELL(I))
* 3.PIPELINE
      PIPCAP=(RES(I,9)*R(I)*RF/100)*2
      COSPIP=(100000+2008*((PIPCAP)**0.834))*RES(I,13)
* 4.TIME DEPENDENT ECONOMICS
      PCOST = 0
      YEAR = 0
      SUM5 = 0
      DO 125 J=1,15
      YEAR =YEAR+1
* 4.1 YEARLY OIL RECOVERY
      YREC= RES(I,9)*R(I)*1.0E04*PERCENT(J)
* 4.2 CO2 SEPARATION/RECYCLE PLANT
      SPRC=YREC
* 4.3 OPERATION COSTS
      OPCOS=(1040+0.1462*RES(I,12))*12*(RES(I,11)+NWELL(I))
```

```
* 4.4 CO2 PURCHASE COSTS
      CO2COS=YREC*6*CO2
* 4.5 YEARLY GROSS REVENUE
      YREV=(YREC*OPRIC)/((1+IRATE)**YEAR)
* 4.6 NPV OF TIME DEPENDENT COSTS
      SUM4=(CO2COS+SPRC+OPCOS)/((1+IRATE)**YEAR)
* 4.7 BEFORE TAXES NPV OF NET INCOME
      SUM5=YREV+SUM5
      PCOST=PCOST+SUM4
 125  CONTINUE
      BTNPV=SUM5-PCOST
* 5 TOTAL COSTS
      TOTCOS=COSNW+COSEQP+COSPIP+PCOST
* 6 NET REVENUE
      NREV=BTNPV-COSNW-COSEQP-COSPIP
* 7 BENEFIT/COST RATIO
      RATRC(I)=NREV/TOTCOS
 110  CONTINUE
      PRINT 1000,(R(I),RATRC(I),NWELL(I),I=1,N2)
      WRITE (6,1000)(R(I),RATRC(I),NWELL(I),I=1,N2)
      PRINT *,'CHANGE ECONOMICAL PARAMETERS? YES=1, NO=0'
      READ *,EC
      IF (EC.EQ.1) THEN
      GO TO 105
      ELSE
      CONTINUE
      ENDIF
1000  FORMAT (1X,F6.2,2X,F6.3,2X,F4.0)
1010  FORMAT (1X,F6.2)
 120  END
```

Post Waterflood CO_2 Miscible Flood in Light Oil

Fluvial-Dominated Deltaic Reservoirs

"DE - FC22 - 93BC14960"

Technical Progress Report

Fourth Quarter, 1996

Executive Summary

CO_2 recycling continue in the Port Neches project with three wells (Kuhn 14, Kuhn 15R and Kuhn 38) producing an average of 48 BOPD. During this period Well Kuhn #15R sanded up due to corrosion problems in the screen and the tubing. Wells Kuhn #14 and #38 were placed on production in an attempt to maintain production to recover any CO_2 displaced oil remaining in the reservoir. Injection of the produced CO_2 and water continue in wells Kuhn #42, Stark #10 and Kuhn #17.

Fourth Quarter 1996, Objectives

* Monitor reservoir performance.

* Evaluate the feasibility of two workovers in wells Kuhn #14 and Stark #8.

After well Kuhn #15R went off production, we evaluated performing workovers on three wells: Kuhn #14, Stark #8 and Kuhn #38. It was decided not to perform any workovers on the wells due to the project economics and the low reservoir yield from its current production. However, we successfully attempted to initiate production from wells Kuhn #14 and Kuhn #38, which are currently making about 60 BOPD.

Discussion of Results - Field Operations

The following is a list of the most recent well tests taken during the month of September 1996, for the producing and injection wells:

Producers:	Kuhn #14,	37 BOPD,	97 % BS&W,	250 PSI,	36 CK.
	Kuhn #38	54 BOPD,	46 % BS&W,	1100 PSI,	11 CK

Injectors:	Kuhn #42,	613 MCFD,	1294 PSI,
	Stark #10,	1691 MCFD,	1295 PSI.
	Kuhn #17,	375 BWPD,	1550 PSI.
	Marg Area 1H,	389 BWPD,	1400 PSI.

Discussion of Results - Technology Transfer

LSU is preparing to issue their final report regarding the screening criteria for application of carbon dioxide miscible displacement in waterflood reservoir containing light oil.

First Quarter 1997, Objectives

* Monitor reservoir performance, and continue project operations if economically feasible.

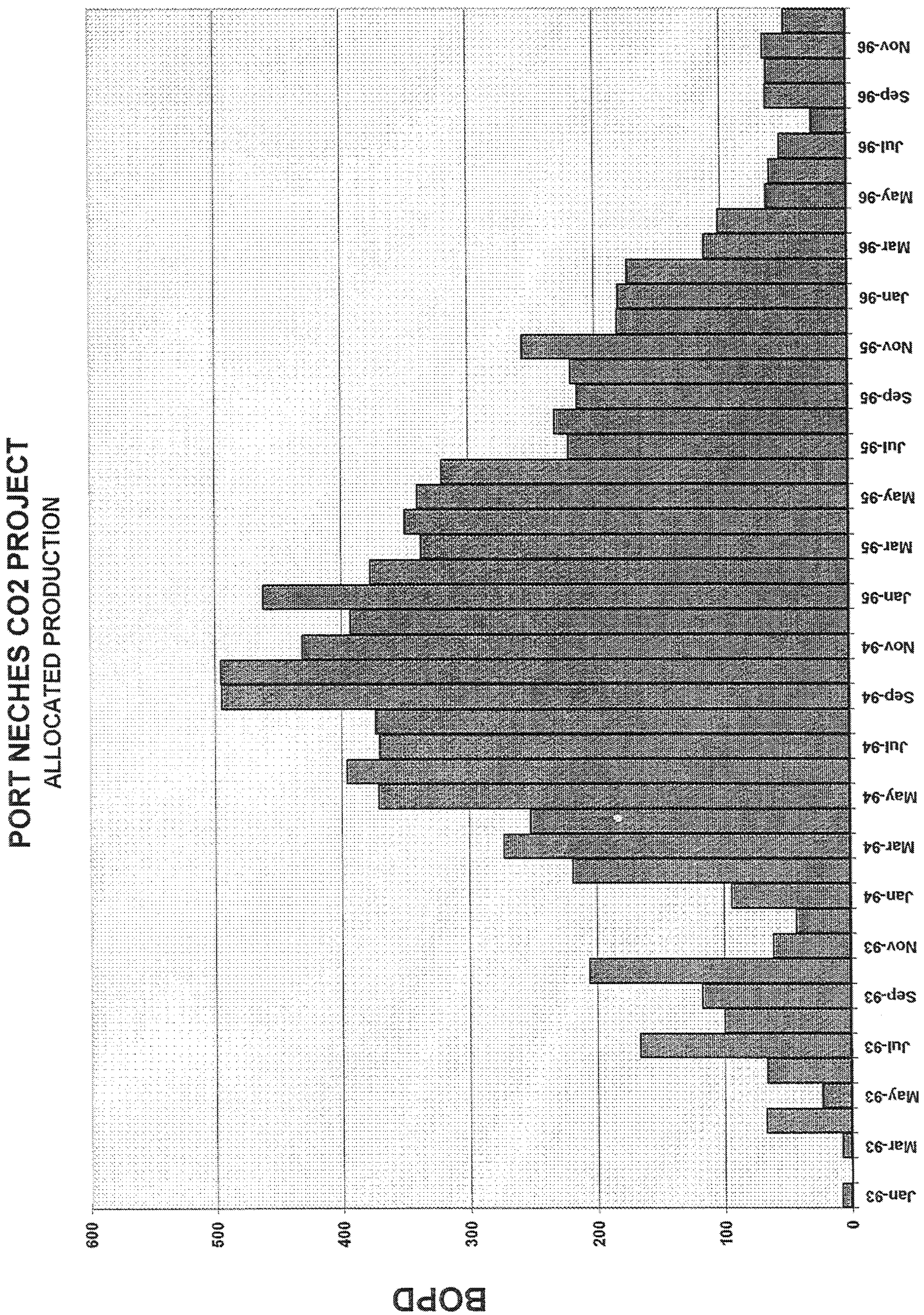
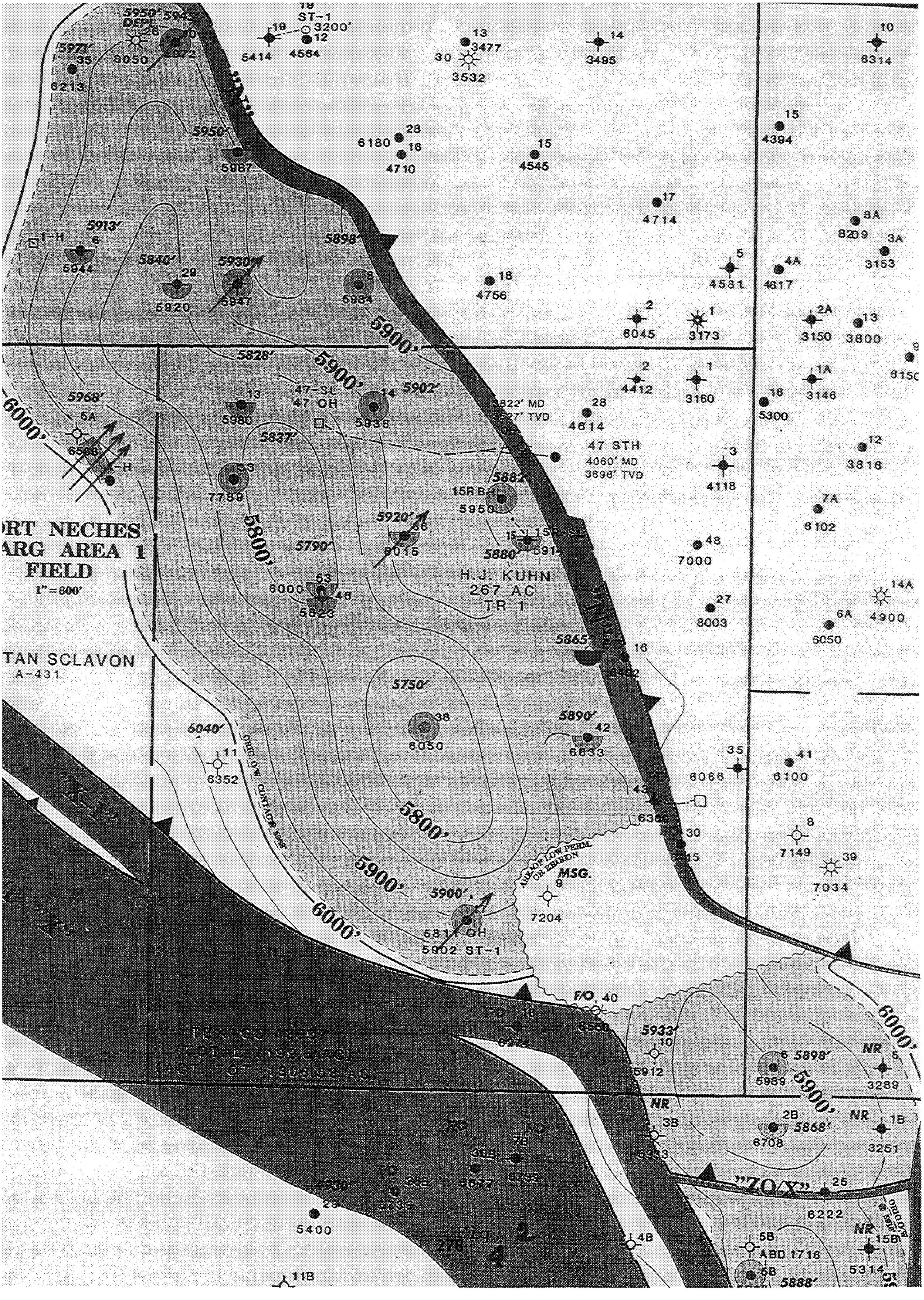

PORT NECHES CO2 PROJECT
ALLOCATED PRODUCTION
BOPD
600
500
400
300
200
100
0
Jan-93
Mar-93
May-93
Jul-93
Sep-93
Nov-93
Jan-94
Mar-94
May-94
Jul-94
Sep-94
Nov-94
Jan-95
Mar-95
May-95
Jul-95
Sep-95
Nov-95
Jan-96
Mar-96
May-96
Jul-96
Sep-96
Nov-96

Fig 1


ORT NECHES
ARG AREA 1
FIELD
1" = 600'
H.J. KUHN
267 AC
TR 1
TAN SCLAVON
A-431
47 STH
4060' MD
3696' TVD
47-SL
47 OH
5900'
5800'
6000'
"70/X"
ORIG O/W CONTACT
AREA OF LOW PERM.
MSG.
5802 ST-1

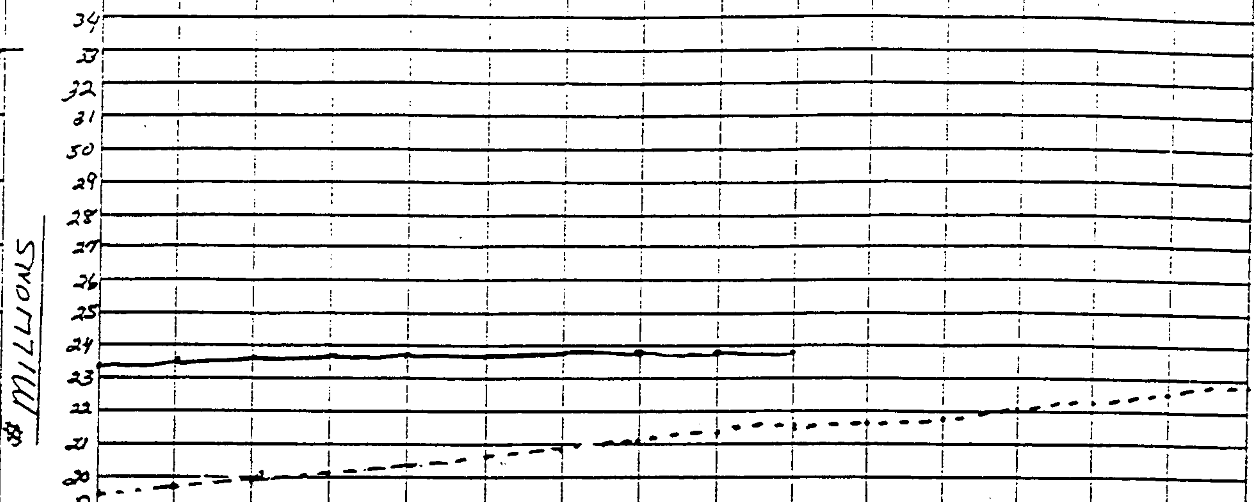
DOE F1332.2
(11-84)

SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER: DE-FC22-93BC14960
2. PROGRAM/PROJECT TITLE: CLASS I
3. REPORTING PERIOD: 9-1-96 thru 9-30-96
4. PARTICIPANT NAME AND ADDRESS: TEXACO Exploration & Production Inc. 400 Poydras St. New Orleans, LA. 70130
5. START DATE: 6-1-93
6. COMPLETION DATE: 12-31-97
7. FY
8. MONTHS: J F M A M J J A S O N D J F M

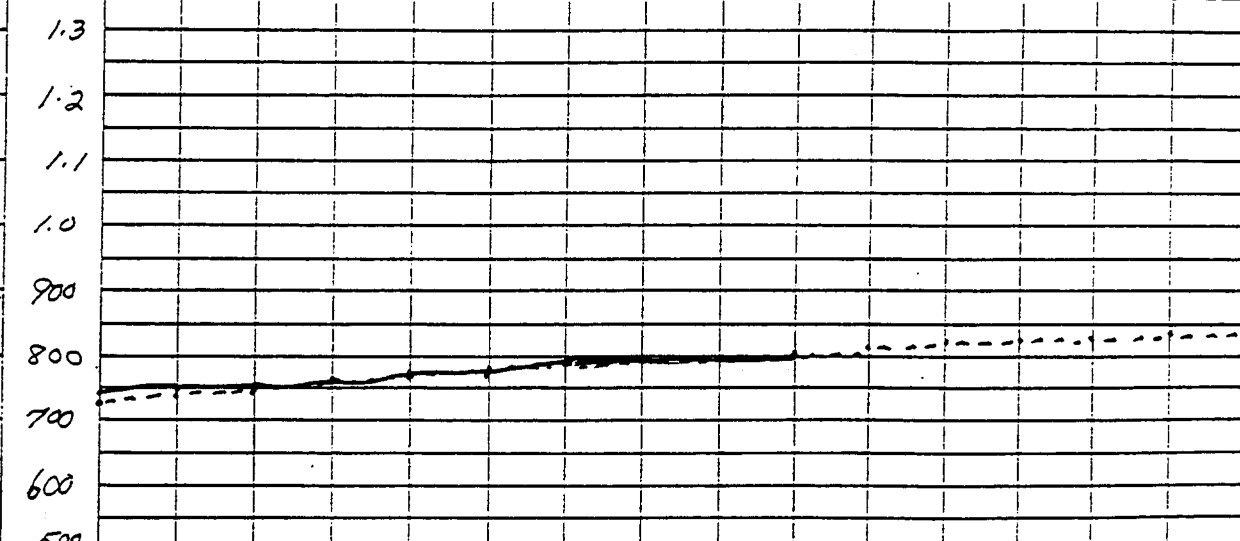
9. COST STATUS
a. $ Expressed in: THOUSANDS
b. Budget and Reporting No.: AC1510100
c. Cost Plan Date: 6-23-93
d. Actual Costs Prior Years: $23,417
e. Planned Costs Prior Years: 19,516
f. Total Estimated Cost for Contract: 10.085
g. Total Contract Value: 2.985
h. Estimated Subsequent Reporting Period



Accrued Costs		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	g. Planned	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
	h. Actual	46	51	65	54	60	147	50	17	11						
	i. Variance	164	159	145	156	150	63	160	193	199						
<867>	j. Cumulative Variance	<203>	<544>	<399>	<243>	<93>	<30>	130	323	522						

10. LABOR STATUS
a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A Direct Lbr
c. Planned Labor Prior Fiscal Years: $731
d. Actual Labor Prior Fiscal Years: $738
e. Total Estimated Labor for Contract: $465
f. Total Contract Labor: N/A

LEGEND
Planned: - - - - - -
Actual: ________
Projected: . . . .



Labor		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	g. Planned	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	h. Actual	0	9	4	5	7	22	4	4	3						
	i. Variance	7	<2>	3	2	0	<15>	3	3	4						
<2>	j. Cumulative Variance	5	3	6	8	8	<7>	<4>	<1>	3						

11. MILESTONES — STATUS — COMMENTS

a.
b. Previous adjustment of <$46,778.88> to year ending
c.
d. Dec. 1995 has been made here. This info
e.
f. based on changing factors for 1995 actuals.
g.

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	**July 1, 1996 - Sept 30, 1996**	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	COMPLETED
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	COMPLETED
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **July 1, 1996 - Sept. 30, 1996**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTIN ELEMENT	9. DURATION 1993 1Q	1993 2Q	1993 3Q	1993 4Q	1994 1Q	1994 2Q	1994 3Q	1994 4Q	1995 1Q	1995 2Q	1995 3Q	1995 4Q	CURRENT FISCAL YEAR 1996 1Q	1996 2Q	1996 3Q	1996 4Q	FY 1997 1Q	1997 2Q	1997 3Q	1997 4Q			10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering				1																			100%	100%
1.2	Extraction Technology				2																			100%	100%
2.1	Recording Daily Production				3															A				50%	50%
2.2	Reservoir Charac-terization				4	B					C													100%	100%
2.3	Site Operation & Field Work		D	5 E					F															100%	100%
2.4	CO2			6																				50%	50%
2.5	EH&S Monitoring & Compliance		G H	7																	I			50%	50%
3.1	CO2 Screening Model						J	8																100%	100%
3.2	Environmental Analysis									9														100%	100%
3.3	FDD Database & Model									K				10										100%	100%
3.4	Technical Publications								L										11					50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

07/10/96

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted U. S. Department of Energy	2. Federal Grant or Other Identifying Number Assigned By Federal Agency DE-FC22-93BC14960	OMB Approval No. 0348-0039	Page 1	of 1 pages
3. Reciepient Organization (Name and complete address, including ZIP code) Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130				
4. Employer Identification Number 51-0265713	5. Recipient Account Number or Identifying Number 323037151	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual	
8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) January 1, 1995	To: (Month, Day, Year) December 31, 1997	9. Period Covered by this Report From: (Month, Day, Year) 04-01-96	To: (Month, Day, Year) 06-30-96	

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$2,930,940.90	$261,800.86	$3,192,741.76
b. Recipient share of outlays (64.39%)	$1,887,232.85	$168,573.57	$2,055,806.42
c. Federal share of outlays (35.61%)	$1,043,708.05	$93,227.29	$1,136,935.34
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$1,043,708.05	$93,227.29	$1,136,935.34
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$1,940,890.95	($93,227.29)	$1,847,663.66

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 107.37%	c. Base $33,369.45	d. Total Amount $35,828.78	e. Federal Share $12,758.63

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title Sami Bou-Mikael - Project Manager	Telephone (Area code, number and extension) (504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted July 10, 1996

Standard Form 269A (REV 4-88)

Previous Editions not Usable

Prescribed by OMB Circulars A-102 and A-110

123/RPT396.WK4

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION	4. Federal grant or other identification number	5. Recipient's account number or identifying number
Name: **Texaco Exploration and Production Inc.**	DE-FC22-93BC14960	[redacted]
Number and Street: **400 Poydras St.**	6. Letter of credit number: NA	7. Last payment voucher number: -
City, State and Zip Code: **New Orleans, Louisiana 70130**	*Give total number for this period*	
	8. Payment Vouchers credited to your account: -	9. Treasury checks received (whether or not deposited): 0

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

10. PERIOD COVERED BY THIS REPORT	
FROM (month,day,year)	TO (month,day,year)
06/01/96	09/30/96

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$170,733.11
	d. Total receipts (Sum of lines b and c)	$170,733.11
	e. Total cash available (Sum of lines a and d)	$170,733.11
	f. Gross disbursements	$170,733.11
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$170,733.11
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

	SIGNATURE	DATE REPORT SUBMITTED
AUTHORIZED CERTIFYING OFFICIAL		11/19/96
	TYPED OR PRINTED NAME AND TITLE	TELEPHONE (Area Code, Number, Extension)
	Sami Bou-Mikael - Project Manager	(504) 593-4565

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

FISCAL YEAR 1995

FISCAL YEAR 1995

INTRODUCTION

In the beginning of 1995 production averaged 459 BOPD but declined to an average of 250 BOPD by year-end. The decline was primarily due to the following factors: fluctuation in GOR and BS&W, low water injectivity in the reservoir, mechanical problems in injection and producing wells, and poor sweep efficiency due to water blockage. The WAG process was continued during 1995. The process had proved itself to be effective in diverting the CO_2 in an effort to improve the sweep efficiency. The reservoir performance had responded favorably to the alternating water and CO_2. A limited CO_2 volume of 120 MMCF was injected to stimulate well Kuhn #6 to test the Huff-Puff process, since the well did not respond to CO_2 injection from the main reservoir.

By February 1995 the Stratamodel showing the reservoir architecture and sand deposition had been built. The reservoir was basically divided into two flow units separated by a shaled out section in the vicinity of Kuhn #9 well. The shaled out area is a fine filled abandoned channel that extends beyond the modeled area east of well Kuhn #9, where several other wells have similar characteristics.

Starting in 1995 we were unable to inject any tangible amount of water in the reservoir since late January. CO_2 injection averaged 11.3 MMCFD, while water injection averaged 1000 BWPD with most of the injection occurring in the month of January.

Reservoir evaluation based on 3D interpretation and BHP taken in wells Kuhn #6 and Polk B #5 confirmed the suspected separation between area 1 and area 2. Also, it confirmed that area 2 is a water drive reservoir open to an aquifer in the south. The newly developed map reduced the reservoir drainage area, thus based on Texaco's prior experience of CO_2 flooding strong water drive reservoirs the recommendation for drilling the Polk B #39 in the Marg Area 2 was cancelled. Furthermore, the Marg

Area 2 did not respond favorably to CO_2 injection in the Kuhn #6 well. For this reason, Texaco did not pursue any further development of this section of the reservoir due mainly to low target reserves.

Also, during 1995 the Marg Area 3 segment was submitted as a natural extension to the rest of the Marge reservoir. The Marge Area 3 was presented to the DOE personnel in Bartlesville and consequently incorporated into the current project area. Texaco drilled the unsuccessful Polk B #39 to test the Marge Area 3. The well was drilled to gain structural position based on the 3D seismic, and found the sand present but no hydrocarbons. Based on this unsuccessful well, no further development was planned for the Marg Area 3. The end of 1995 initiated a second WAG cycle by converting Kuhn #17 to water injection and well Stark #7 to CO_2 injection. The following pages are the quarterly reports and attachments for the fiscal year 1995.

FLUVIAL DOMINATED DELTAIC RESERVOIRS"

"DE-FC22-93BC14960"
TECHNICAL PROGRESS REPORT

1st QUARTER, 1995.

EXECUTIVE SUMMARY.

Production is averaging about 450 BOPD for the quarter. The fluctuation was primarily due to a temporary shutdown of CO_2 delivery and maturing of the first WAG cycle. CO_2 and water injection were reversed again in order to optimize changing yields and water cuts in the producing wells. Measured BHP was close to the anticipated value. A limited CO_2 volume of 120 MMCF was injected to stimulate well Kuhn #6 to test the Huff-Puff process, since the well did not respond to CO_2 injection from the main reservoir. The well will be placed on February 1, 1995. Total CO_2 injection averaged this quarter about 8.8 MMCFD, including 3.6 MMCFD purchased CO_2 from Cardox.

1st QUARTER (1995) OBJECTIVES

* Reverse the WAG cycle, in order to increase the CO_2 sweep efficiency. Monitor the producing wells performance.

The application of the WAG process in high porosity, high permeability sandstone reservoirs is unique and proving to be effective in diverting the CO_2 in an effort to improve the sweep efficiency. The reservoir performance has responded favorably to the alternating water and CO_2. Figure 3 shows the change in the reservoir daily production and yield in June and December when the switch was made in the injection wells. The results of the second switch back to the original well status (i.e. Wells Marg Area 1-H, Stark #7 and Kuhn # 36 injecting CO_2, Wells Stark 10 and Kuhn #17 injecting water) can not be fully evaluated at this time, however early indications are positive. The need for additional cycles as well as the timing will be evaluated in the future as dictated by reservoir performance. Also we will evaluate switching wells Stark #7 and Kuhn #36 to producers when the reservoir simulator is completed.

<u>* Huff-Puff well Kuhn #6 with a limited slug of CO_2 (100 MMCF), followed by a 3 weeks shut in period, then place the well on production.</u>

After laying 1700' of welded injection line to the well, CO_2 injection began in early December and continued until a total of 127 MMCF was injected. Currently the well is shut in for 3 weeks soaking period, then the well will be open for production on February 1, 1995. The response from the well to the CO_2 Huff-Puff mechanism is proportional to the oil saturation around the wellbore, the reservoir pressure and the oil composition or crude gravity. The deeper the CO_2 penetration through the reservoir fluid the higher the oil recovery will be. As the CO_2 penetrates through the oil initially it bypasses the oil during the Huff phase, then it soaks into the oil and depending on the pressure it may become miscible in the oil. During the Puff phase the CO_2 at certain suitable conditions will recover between 3000 to 15000 Bbls of oil. Additional CO_2 injection cycles can be performed if the recovery from the first cycle was economical.

The BHP's measured in wells Kuhn #6 and Polk B#5 before and after the Huff-Puff cycle are shown below, indicate a separation between the two wells. Additional BHP's will be run in the two wells after the soak period and prior to opening the wells to production. This contradicts the initial analysis obtained from the 3-D seismic. This will require further evaluation which will delay the drilling of the last injection well in Area 2 of the project (Polk B#39). Currently we are evaluating initiating another Huff-Puff operation on well Polk B#5. The workover on well Polk B #5 was performed to prevent any potential oil spill in the case the well is connected to Well Kuhn #6 which is undergoing the first Huff-Puff cycle. This workover was planned for early 1995 along with the new drilling well Polk B#39.

* Build a detailed strata model to use it in the development of the improved compositional model.

A Stratamodel showing the reservoir architecture and sand deposition has been built. Fine tuning the model will be complete by the end of January 1995. The reservoir basically is divided into two flow units separated by a shaled out section in the vicinity of Kuhn #9 well. The shaled out area is a fine filled abandoned channel that extends beyond the modeled area East of well Kuhn #9, where several other wells have similar characteristics. The segment to the north of the shaled out area, the sand interval is relatively thin, with the best reservoir quality is to the base of the sand. Toward the top of the sand the reservoir quality varies considerably laterally and vertically, characteristic of individual channel-fill sands. South of the shaled out area the sand is thicker, cleaner and more uniform sand distribution. The sand maintains good lateral and vertical reservoir quality. However, some small deterioration of sand quality occurs in stratigraphically higher portions of the sand as expected for channel sands deposit. Homogeneity of the Marginulina sand in the southern area should promote good performance. For additional information on the methodology, software used and analysis of results please refer to the appendix.

* Submit the Project Evaluation and Continuation Application, Environmental Constrain Report and the 1994 Annual Report.

The Project Evaluation and Continuation Application has been submitted to the DOE by the due date. The DOE has approved the Continuation Application for $2,984,599 through 1997. Also, the Environmental Constrain Report and the 1994 Annual Report have been submitted by the due date.

DISCUSSION OF RESULTS - FIELD OPERATIONS.

The measured reservoir pressure in well Kuhn #6 indicated that we have a slight decline in pressure in this side of the reservoir to 2602 psi. This contradicts somewhat the estimates from material balance of net reservoir voidage that predicts a increasing trend of reservoir pressure. This anomaly may be a direct result of temporary cessation of CO_2 delivery by Dupont for two weeks, and the simultaneous reduction of water injection due to pump breakdown. The WAG cycle was reversed between the water and CO_2 injection wells, after observing a declining trend in reservoir production and yield. the current daily production level is about 500 BOPD. The plan to increase production from Kuhn #6 and Polk B#5 has been delayed about 4 to 6 months due to delay in performing the work for budgetary constrains some technical data related to mapping reinterpretation. This will result in loss of 75 to 10 BOPD for a period of 6 months.

The following is a list of the most recent well tests taken on January 3, 1995 for all the producing and injection wells:

Kuhn #15R	97 BOPD,	550 BWPD,	380 MMCFD,	17 CHOKE.
Kuhn #38	245 BOPD,	276 BWPD,	3310 MMCFD,	22 CHOKE.
KUHN #33	56 BOPD,	874 BWPD,	381 MMCFD,	18 CHOKE.
STARK #8	101 BOPD,	464 BWPD,	2011 MMCFD,	28 CHOKE.
KUHN #6	0 BOPD,	0 BWPD,	0 MMCFD,	OL CHOKE.
KUHN #14	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.
POLK #B5	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.

MARG AREA #1H	5483 MMCFD,	1300 PSI.
KUHN #36	3188 MMCFD,	1380 PSI.
STARK #7	1155 MMCFD,	1500 PSI.
KUHN #17	1958 BWPD,	1600 PSI.
STARK #10	1821 BWPD,	1790 PSI.

The average injection and production volumes for this quarter are as follow:

Oil Production:	435 BOPD.
Water Production:	2581 BWPD.
Gas Production:	5528 MMCFD.
Water Injection:	2680 BWPD.
Gas Injection:	8919 MMCFD.
Reservoir Voidage:	1780 BPD.

Allocated production, CO_2 delivery, Reservoir yield, wells' performance, reservoir pressure and reservoir voidage plots are included in Figure 1 through 9

DISCUSSION OF RESULTS - TECHNOLOGY TRANSFER.

The Environmental Constrain Topical Report has been finalized and submitted to the DOE on time. LSU finished screening and preparing the database for FDD reservoirs in South Louisiana, identifying CO_2 sources in South Louisiana and East Texas and update and expand existing maps if fields locations to determine proximity to CO_2 sources. A report will be issued during the spring semester to cover the completed work. Additionally LSU will be selecting one reservoir to apply the screening techniques and perform a reservoir analysis. LSU work will be extended through 1996.

2nd Quarter (1995) Objectives.

* Monitor and optimize reservoir production.

* Evaluate performing Huff-Puff cycle on well Polk B#5.

* Evaluate the need to drill well Polk B#39 in project Area 2, using BHP data and 3-D mapping.

* Resume working on the reservoir compositional model. Set a target date to complete the model by June 30, 1995.

* Evaluate a workover on either Kuhn # 16 or Kuhn #42, to improve reservoir sweep efficiency, and to increase the production rate.

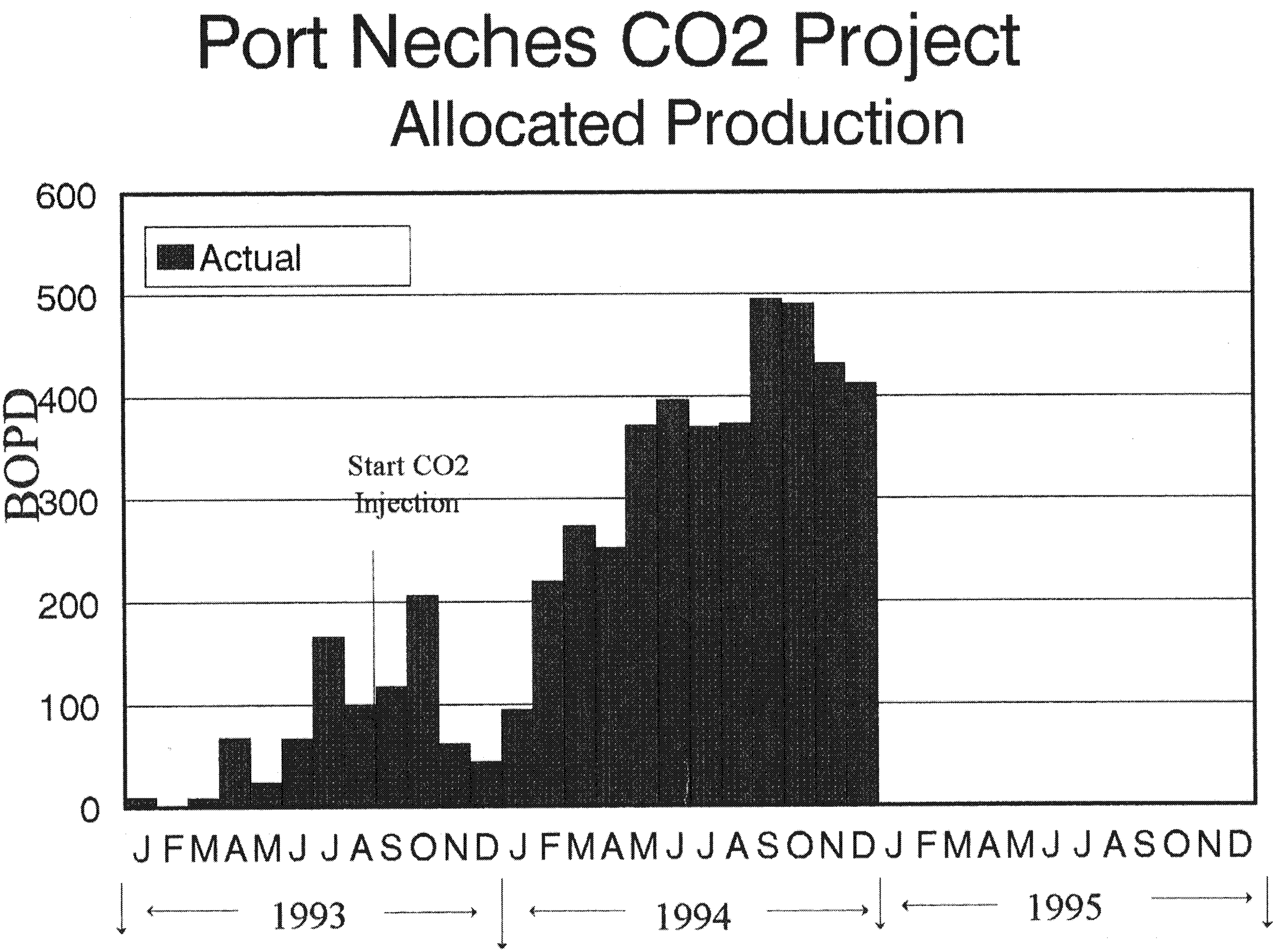

Port Neches CO2 Project
Allocated Production
Actual
BOPD
600
500
400
300
200
100
0
Start CO2
Injection
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1993
1994
1995

FIG. 1

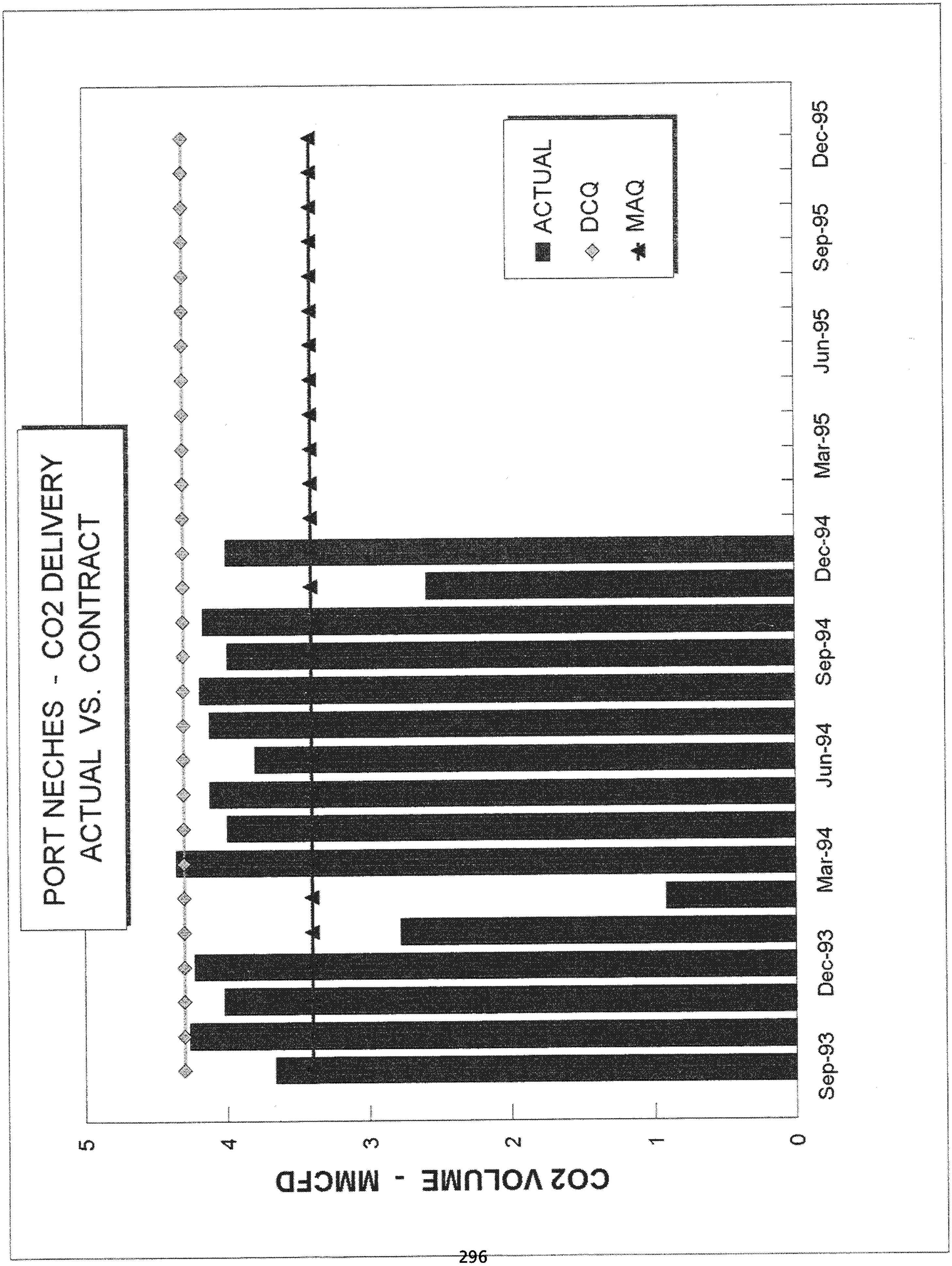

PORT NECHES - CO2 DELIVERY
ACTUAL VS. CONTRACT
ACTUAL
DCQ
MAQ
CO2 VOLUME - MMCFD
0
1
2
3
4
5
Sep-93
Dec-93
Mar-94
Jun-94
Sep-94
Dec-94
Mar-95
Jun-95
Sep-95
Dec-95

FIG. 2

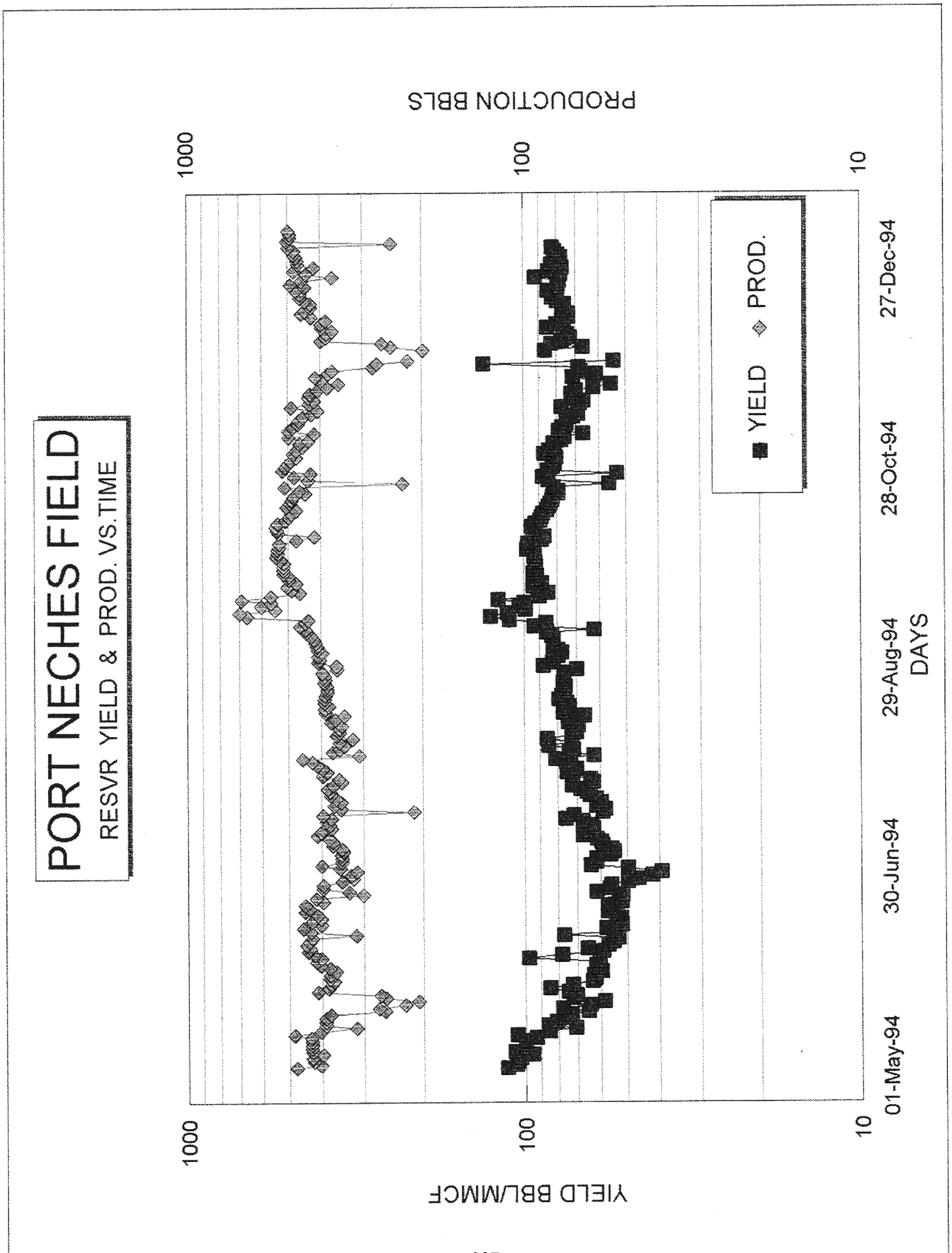

PORT NECHES FIELD
RESVR YIELD & PROD. VS.TIME
PRODUCTION BBLS
1000
100
10
YIELD BBL/MMCF
1000
100
10
01-May-94
30-Jun-94
29-Aug-94
28-Oct-94
27-Dec-94
DAYS
YIELD
PROD.

FIG. 3

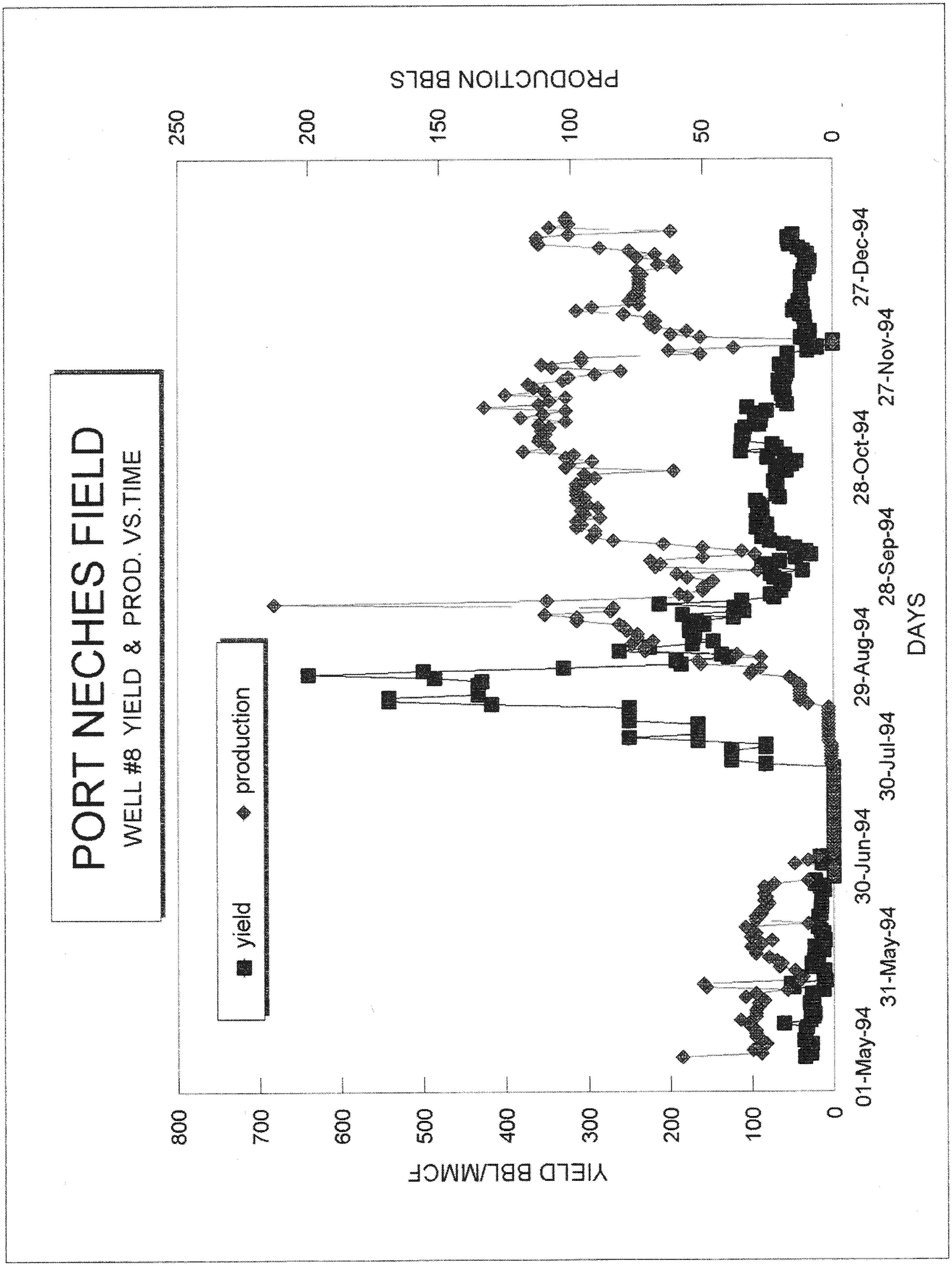
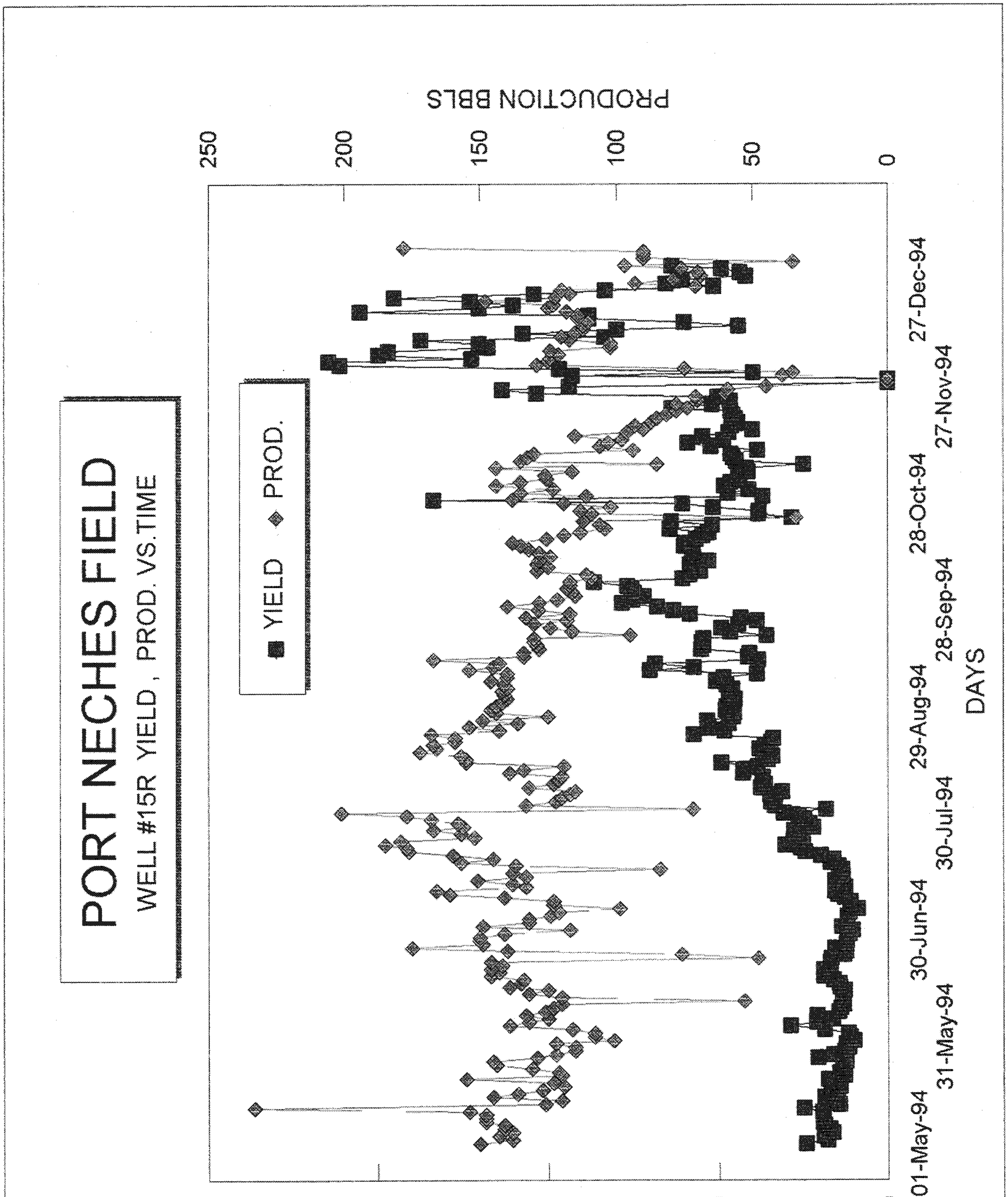

PORT NECHES FIELD
WELL #8 YIELD & PROD. VS.TIME
yield
production
YIELD BBL/MMCF
PRODUCTION BBLS
DAYS
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94

FIG. 4



PORT NECHES FIELD
WELL #15R YIELD , PROD. VS.TIME
YIELD
PROD.
YIELD BBL/MMCF
PRODUCTION BBLS
DAYS
0
200
400
600
800
0
50
100
150
200
250
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94

FIG. 299

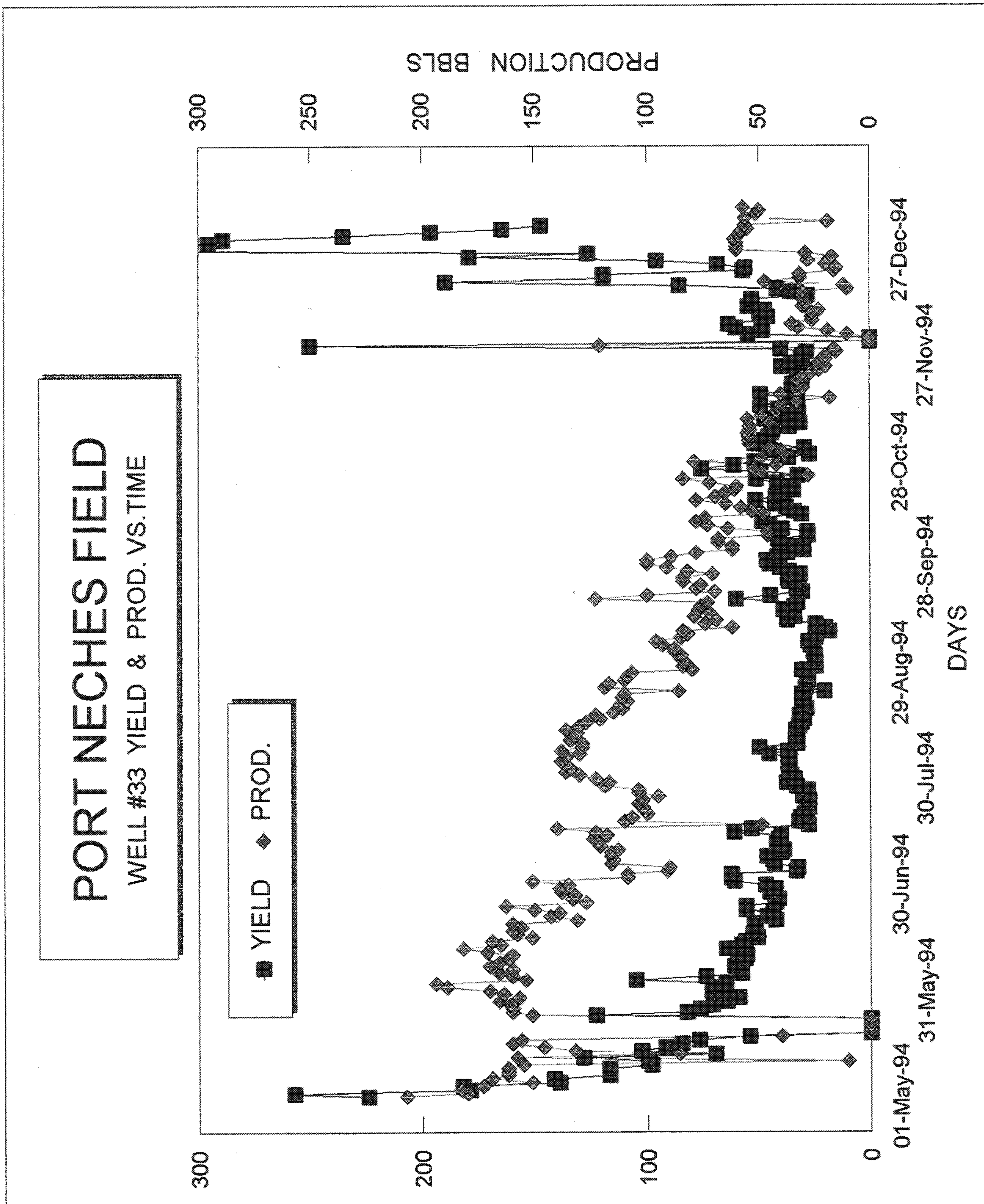

PORT NECHES FIELD
WELL #33 YIELD & PROD. VS.TIME
YIELD
PROD.
PRODUCTION BBLS
300
250
200
150
100
50
0
YIELD BBL/MMCF
300
200
100
0
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
DAYS

FIG. 6

300

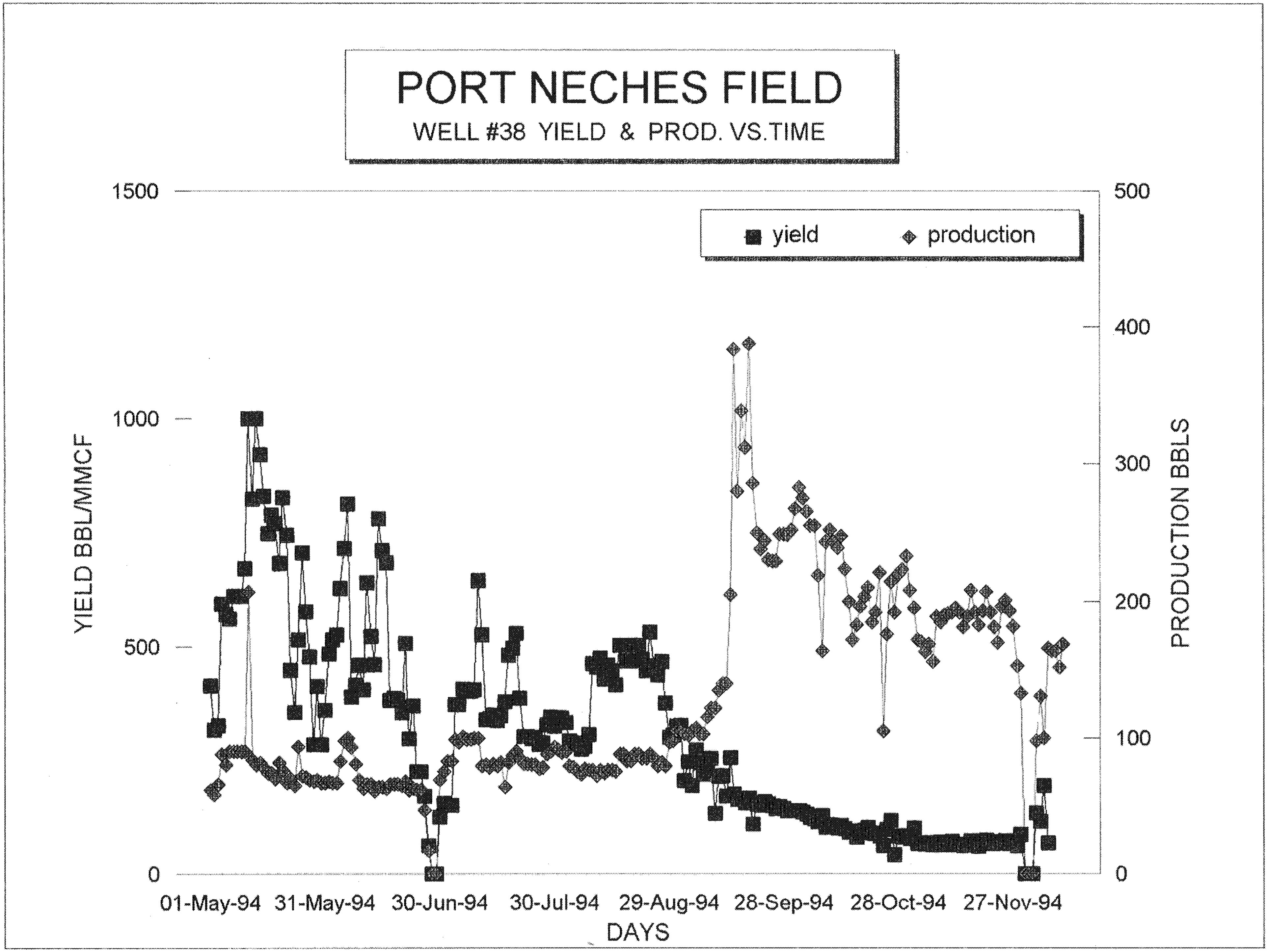
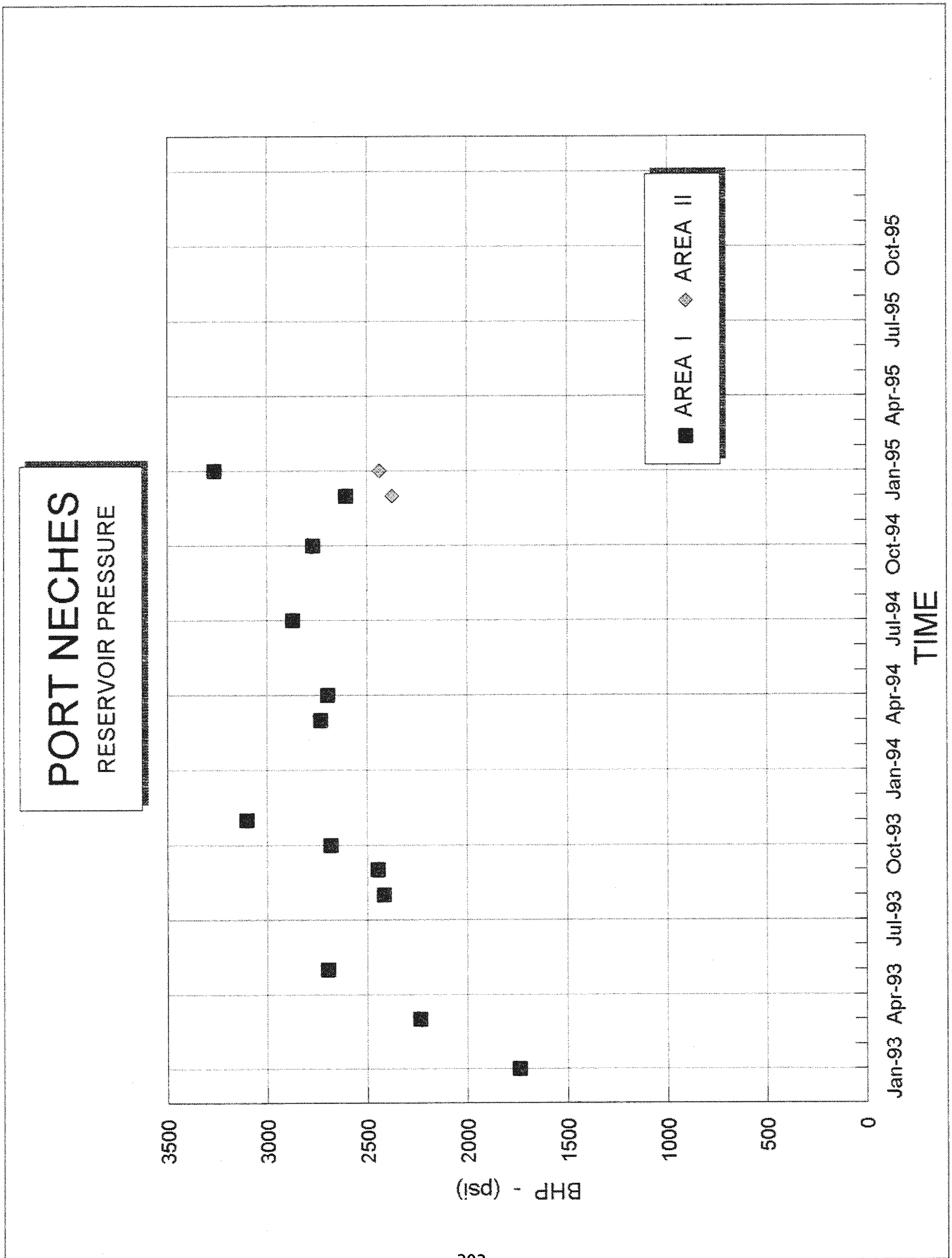

PORT NECHES FIELD
WELL #38 YIELD & PROD. VS.TIME
yield
production
YIELD BBL/MMCF
PRODUCTION BBLS
1500
1000
500
0
500
400
300
200
100
0
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
DAYS

FIG. 30



PORT NECHES
RESERVOIR PRESSURE
BHP - (psi)
3500
3000
2500
2000
1500
1000
500
0
Jan-93
Apr-93
Jul-93
Oct-93
Jan-94
Apr-94
Jul-94
Oct-94
Jan-95
Apr-95
Jul-95
Oct-95
TIME
AREA I
AREA II

FIG. 8

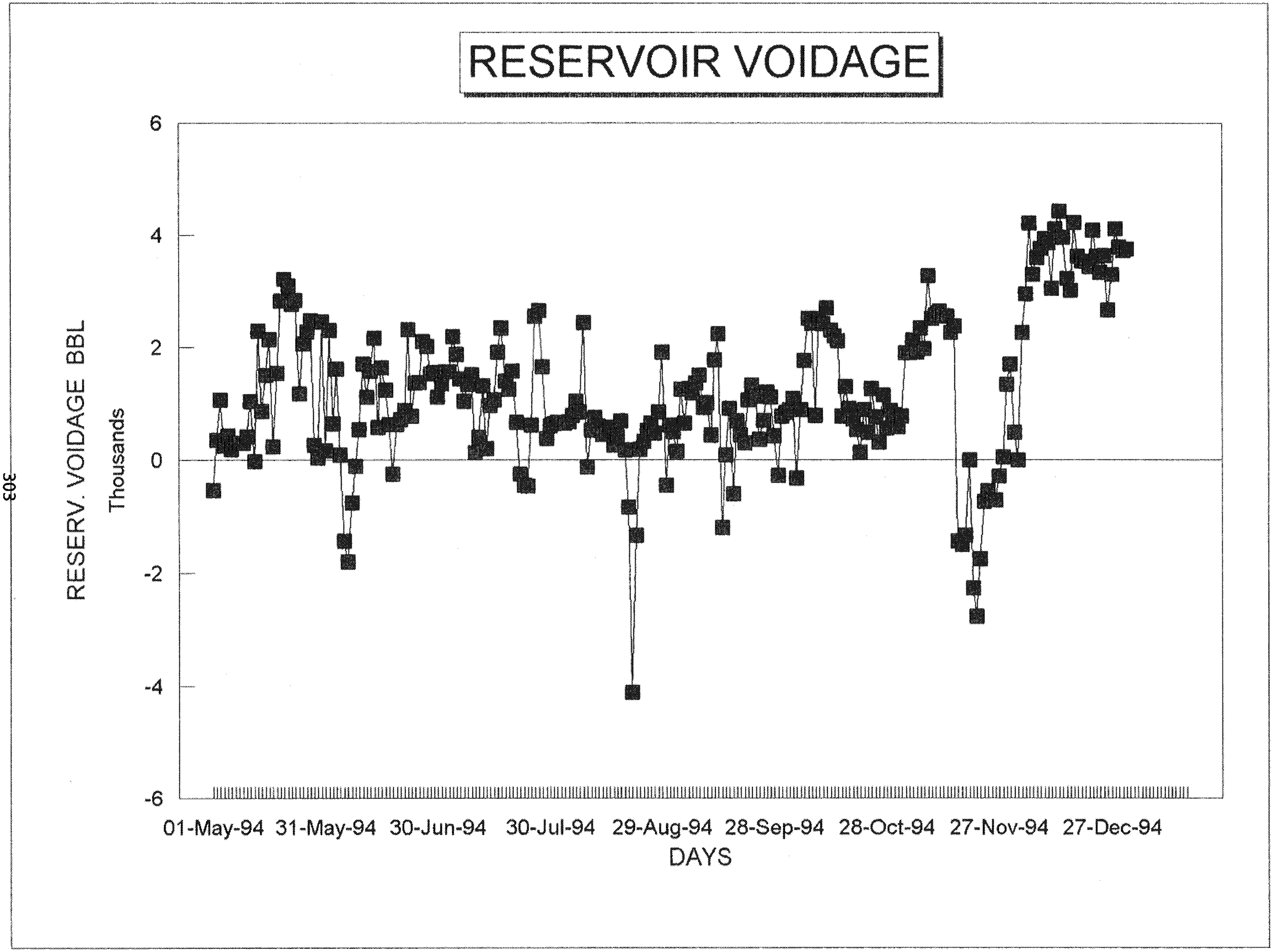

RESERVOIR VOIDAGE
RESERV. VOIDAGE BBL
Thousands
6
4
2
0
-2
-4
-6
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
DAYS

FIG. 9

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER	2. PROGRAM/PROJECT TITLE	3. REPORTING PERIOD
DE-FC22-93BC14960	Class I	10-1-94 to 12/31/94

4. PARTICIPANT NAME AND ADDRESS
Texaco Exploration And Production, Inc
400 Poydras St.
New Orleans, LA 70130

5. START DATE: 6-1-93

6. COMPLETION DATE 12-31-97

7. FY

8. MONTHS: O N D J F M A M J J A S O N D

9. COST STATUS

a. $ Expressed in: Millions

b. Budget and Reporting No. AC1510100

c. Cost Plan Date 6-23-93

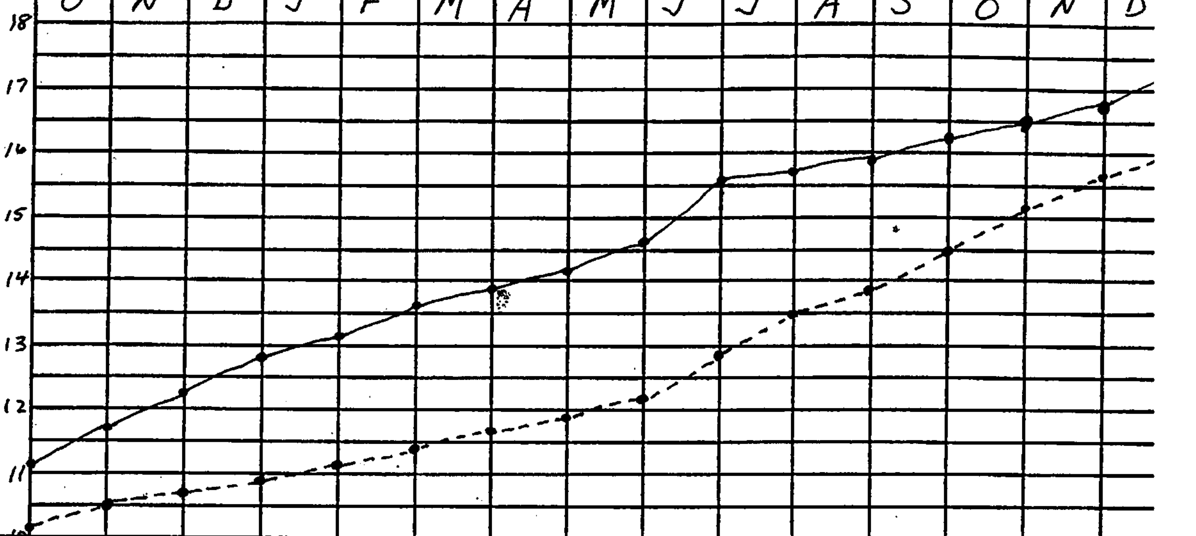
d. Actual Costs Prior Years 11,317

e. Planned Costs Prior Years 10,149

f. Total Estimated Cost for Contract $646

g. Total Contract Value $5,407

h. Estimated Subsequent Reporting Period



Accrued Costs	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	352	280	209	206	210	230	256	255	706	704	277	248	630	630	214
h. Actual	635	612	595	239	454	291	436	364	966	188	224	426	212	238	313
i. Variance	<283>	<332>	<386>	<33>	<244>	<61>	<180>	<109>	<260>	516	60	<178>	418	392	<99
j. Cumulative Variance	<1351>	<1683>	<2069>	<2102>	<2346>	<2407>	<2587>	<2696>	<2956>	<2,440>	<2380>	<2558>	<2140>	<1748>	<184

10. LABOR STATUS

a. Labor Expressed in: Thousands

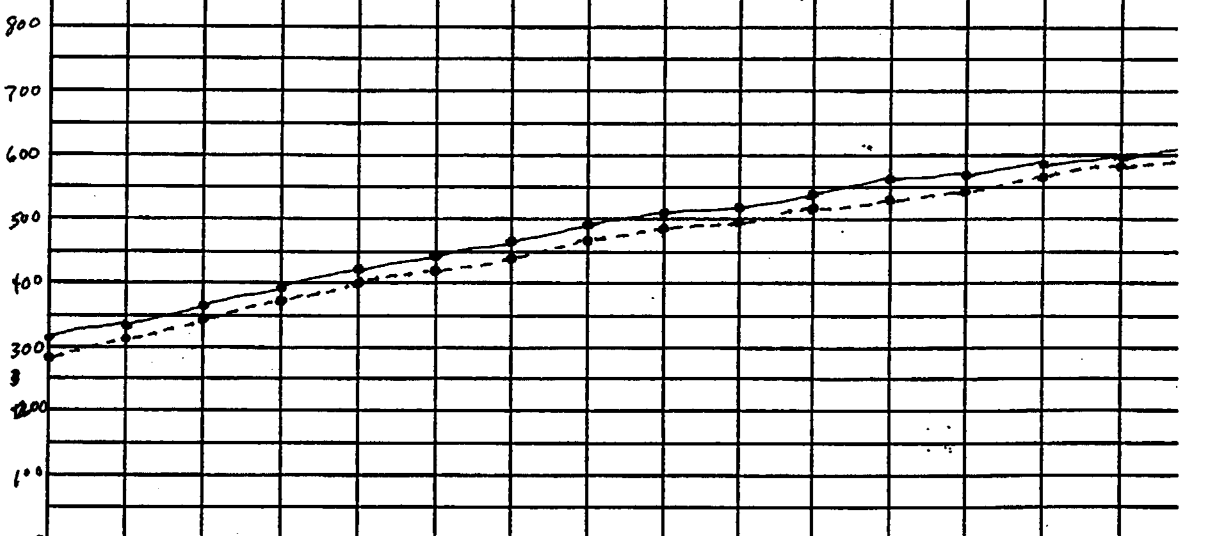
b. Labor Plan Date: N/A Direct Labor

c. Planned Labor Prior Fiscal Years $390

d. Actual Labor Prior Fiscal Years $312

e. Total Estimated Labor for Contract $1,275

f. Total Contract Labor N/A



LEGEND
Planned: - - - - - -
Actual: ________
Projected: . . . .

Labor	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	30	30	25	25	20	20	15	15	15	15	15	15	15	15	15
h. Actual	26	29	20	31	38	17	18	18	17	20	15	14	13	11	9
i. Variance	4	1	5	<6>	<18>	3	<3>	<3>	<2>	<5>	0	1	2	4	6
j. Cumulative Variance	<18>	<17>	<12>	<18>	<36>	<33>	<36>	<39>	<41>	<46>	<46>	<45>	<43>	<39>	<33>

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Oct. 1, 1994 - Dec. 31, 1994**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTING ELEMENT	9. DURATION CURRENT FISCAL YEAR 1993 Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	FY 1994 1Q	2Q	3Q	4Q	FY 1995 1Q	2Q	3Q	4Q	FY 1996	FY 1997	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering	1																						100%	100%
1.2	Extraction Technology	2																						100%	100%
2.1	Recording Daily Production										3												A	40%	40%
2.2	Reservoir Charac-terization										4			B				C						80%	80%
2.3	Site Operation & Field Work							D				5	E					F						90%	90%
2.4	CO2											6												35%	35%
2.5	EH&S Monitoring & Compliance								G	H		7											I	40%	40%
3.1	CO2 Screening Model														J	8								100%	100%
3.2	Environmental Analysis																	9						100%	100%
3.3	FDD Database & Model																	K				10		50%	50%
3.4	Technical Publications																L						11	40%	40%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO_2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	**Oct. 1, 1994 - Dec. 31, 1994**	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	PROJECT 10% COMPLETE
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	TO BE PERFORMED DURING 1995
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	TO BE DRILLED DURING 1995
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	LSU WORK WILL BE COMPLETED IN SPRING, 1996
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	SUBMITTED @ SPE/DOE SYMPOSIUM

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No. 0348-0039	Page	of
U. S. Department of Energy	DE-FC22-93BC14960		1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	[redacted]	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
June 1, 1993	December 31, 1994	10-01-94	12-31-94

10 Transactions		I Previously Reported	II This Period	III Cumulative
a. Total outlays		$16,551,935.38	$1,003,494.99	$ 17,555,430.37
b. Recipient share of outlays	(64.39%)	$10,657,791.19	$646,150.42	$ 11,303,941.62
c. Federal share of outlays	(35.61%)	$5,894,144.19	$357,344.57	$ 6,251,488.75
d. Total unliquidated obligations		0.00	0.00	0.00
e. Recipient share of unliquidated obligations		0.00	0.00	0.00
f. Federal share of unliquidated obligations		0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)		$5,894,144.19	$357,344.57	$ 6,251,488.75
h. Total Federal funds authorized for this funding period		$5,539,225.00	$0.00	$ 5,539,225.00
i. Unobligated balance of Federal funds (Line h minus line g)		($354,919.19)	($357,344.57)	$ 0.00

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 108.84%	c. Base $ 32,907.26	d. Total Amount $ 35,816.26	e. Federal Share $ 12,754.17

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Sami Bou-Mikael - Project Manager	(504) 593-4565
Signature of Authorized Certifying Official	**Date Report Submitted**
	January 17, 1995

Previous Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

3. FEDERAL EMPLOYER IDENTIFICATION NO> 51-0265713

4. Federal grant or other identification number: **DE-FC22-93BC14960**

5. Recipient's account number or identifying number: [redacted]

6. Letter of credit number: **NA**

7. Last payment voucher number: -

Give total number for this period

8. Payment Vouchers credited to your account: -

9. Treasury checks received (whether or not deposited): 0

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year): **10/01/94** TO (month,day,year): **12/31/94**

11. STATUS OF FEDERAL CASH		
	a. Cash on hand beginning of reporting period	$ 0.00
	b. Letter of credit withdrawals	0.00
	c. Treasury check payments	0.00
	d. Total receipts (Sum of lines b and c)	0.00
	e. Total cash available (Sum of lines a and d)	0.00
	f. Gross disbursements	0.00
	g. Federal share of program income	0.00
	h. Net disbursements (Line f minus line g)	0.00
	i. Adjustments of prior periods	0.00
	j. Cash on hand end of period	$ 0.00

12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$ 0.00
	l. Advances to subgrantees or subcontractors	$ 0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED **01/17/95**
	TYPED OR PRINTED NAME AND TITLE **Sami Bou-Mikael - Project Manager**	TELEPHONE (Area Code, Number, Extension) **(504) 593-4565**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110

POST WATERFLOOD CO_2 MISCIBLE FLOOD IN LIGHT OIL
FLUVIAL DOMINATED DELTAIC RESERVOIRS"

"DE-FC22-93BC14960"
TECHNICAL PROGRESS REPORT

2nd QUARTER, 1995.

EXECUTIVE SUMMARY

Production from the Marg Area 1 at Port Neches is averaging 392 BOPD for this quarter. The production drop is due to fluctuation in both GOR and BS&W on various producing wells, coupled with low water injectivity in the reservoir. We were unable to inject any tangible amount of water in the reservoir since late January. Both production and injection problems are currently being evaluated to improve reservoir performance. Well Kuhn #6 was stimulated with 120 MMCF of CO_2, and was placed on production in February 1, 1995. The well was shut in for an additional month after producing dry CO_2 initially. The well was opened again in early April and is currently producing about 40 BOPD. CO_2 injection averaged 11.3 MMCFD including 4100 MMCFD purchased from Cardox, while water injection averaged 1000 BWPD with most of the injection occurring in the month of January.

2nd QUARTER (1995) OBJECTIVES

* Monitor and optimize reservoir production.

Recent decline in reservoir production from 450 to 392 BOPD is mainly due to fluctuation in the GOR and BS&W of several producing wells. We are currently evaluating if the decline is due to possible wellbore mechanical problems. We observed a decline in the reservoir yield associated with the production drop, suggesting the need to resume a second WAG cycle in order to reduce CO_2 production and increase the sweep efficiency. Evaluation is currently underway to improve water injectivity in the reservoir in order to maintain pressure and improve sweep efficiencies. Most of the production decline is attributed to wells Kuhn #15R and Kuhn #38.

* Evaluate performing a huff-puff cycle on well Polk B#5.

A workover was planned on the subject well for the first quarter of 1995, along with the drilling of well Polk B#39. However, the well workover was performed earlier on an emergency basis to install a tree and a packer due to increasing pressure in the wellbore. This work was necessary to prevent any potential oil spill in case the well started to flow.

Based on the well readiness and the performance of the first huff-puff cycle in well Kuhn #6, which is currently flowing about 35 BOPD, it is recommended to lay an injection line to Polk B#5 and inject a similar volume of CO_2 (120 MMCF). It is anticipated that this work will be performed by mid May. Kuhn #6 performance is also indicative of a water drive reservoir where we have an initial yield of 40 BO/MMCF.

* Evaluate the need to drill well Polk B#39 in project Area 2, using BHP data and 3-D mapping.

Current reservoir evaluation based on recent 3D interpretation and BHP taken in wells Kuhn #6 and Polk B#5 confirmed the suspected separation between area 1 and area 2. Also it confirmed that area 2 is a water drive reservoir open to an aquifer in the south. The newly developed map reduced the reservoir drainage area which in turn reduced the remaining oil target. Based on the above and on Texaco's prior experience of CO_2 flooding strong water drive reservoirs, the anticipated recovery from this portion of the reservoir does not justify drilling a new injection well. Therefore we recommend canceling the drilling of well Polk B#39 in the Marg Area 2. Instead we recommend to proceed with the Huff-Puff of well Polk B#5, in order to maximize recovery of hydrocarbon from this area of the reservoir.

* Resume working on the reservoir compositional model. Set a target date to complete the model by June 30, 1995.

The stratamodel was completed early this quarter and it is available to input in the compositional model. However, the compositional modeling of the reservoir will be delayed for sometime due to personnel availability. This delay will not hinder our ability to operate the project.

* Evaluate a workover on either Kuhn # 16 or Kuhn #42, to improve reservoir sweep efficiency, and to increase the production rate.

Texaco is planning to perform a workover to plugdown well Kuhn #42 to the Marg Area 1. This well will allow us to sweep a new area and recover additional oil from the reservoir that will not be recovered otherwise. This well performance should be comparable to well Kuhn #15R. The well is anticipated to produce at a rate of 150 BOPD initially.

DISCUSSION OF RESULTS - FIELD OPERATIONS

Repeated measurement of BHP in wells Kuhn #6 and Polk B#5 confirmed the presence of a fault separating the two wells. Also the increased BHP due to CO_2 injection in well Kuhn #6 (3300 psi), above the normal reservoir pressure (2700 psi) suggests the possible presence of a permeability barrier between Kuhn #6 and the main part of the reservoir. Stratamodel also suggested the same idea. Reservoir performance has been declining recently due to decreased water injectivity, as well as possible mechanical problems in the producing wells. Texaco is planning to check the integrity of sand control systems in the producing wells in order to restore higher production rates. Expense workovers may be required to change the gravel pack settings in the affected wells. Similar evaluation will be conducted on the injection wells to restore high water injection rates.

The following is a list of the most recent well tests taken on March 31, 1995 for all the producing and injection wells:

Kuhn #15R	120 BOPD,	480 BWPD, 2550 MMCFD, 17 CHOKE.
Kuhn #38	132 BOPD,	1335 BWPD, 2460 MMCFD, 22 CHOKE.
KUHN #33	63 BOPD,	170 BWPD, 2650 MMCFD, 18 CHOKE.
STARK #8	54 BOPD,	332 BWPD, 2646 MMCFD, 28 CHOKE.

KUHN #6	0 BOPD,	0 BWPD,	0 MMCFD,	OL CHOKE.
KUHN #14	- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.
POLK #B5	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.

MARG AREA #1H	4312 MMCFD,	1220 PSI.
STARK #7	1058 MMCFD,	1390 PSI.
STARK #10	2743 MMCFD,	1400 PSI.
Kuhn #17	2763 MMCFD,	1390 PSI.

The average injection and production volumes for this quarter are as follow:

Oil Production:	392 BOPD.
Water Production:	2208 BWPD.
Gas Production:	7760 MMCFD.
Water Injection:	1007 BWPD.
Gas Injection:	11300 MMCFD.
Reservoir Voidage:	509 BPD.

Allocated production, CO_2 delivery, Reservoir yield and wells' performance plots are included in Figure 1 through 8.

DISCUSSION OF RESULTS - TECHNOLOGY TRANSFER.

Following the quarterly report is an article summarizing LSU's completed work covering the following topics:

* History of CO_2 use in EOR efforts in Louisiana.

* Jackson Dome (Shell) Pipeline.

* CO_2 Sources/Providers in Louisiana.

* Preliminary Ranking of Reservoirs Suitable for Post Waterflood CO_2 Miscible Flooding.

* Tertiary CO_2 Enhanced Oil Recovery Map.

LSU is planning on transferring this information to the industry via SPE papers and/or industry forums.

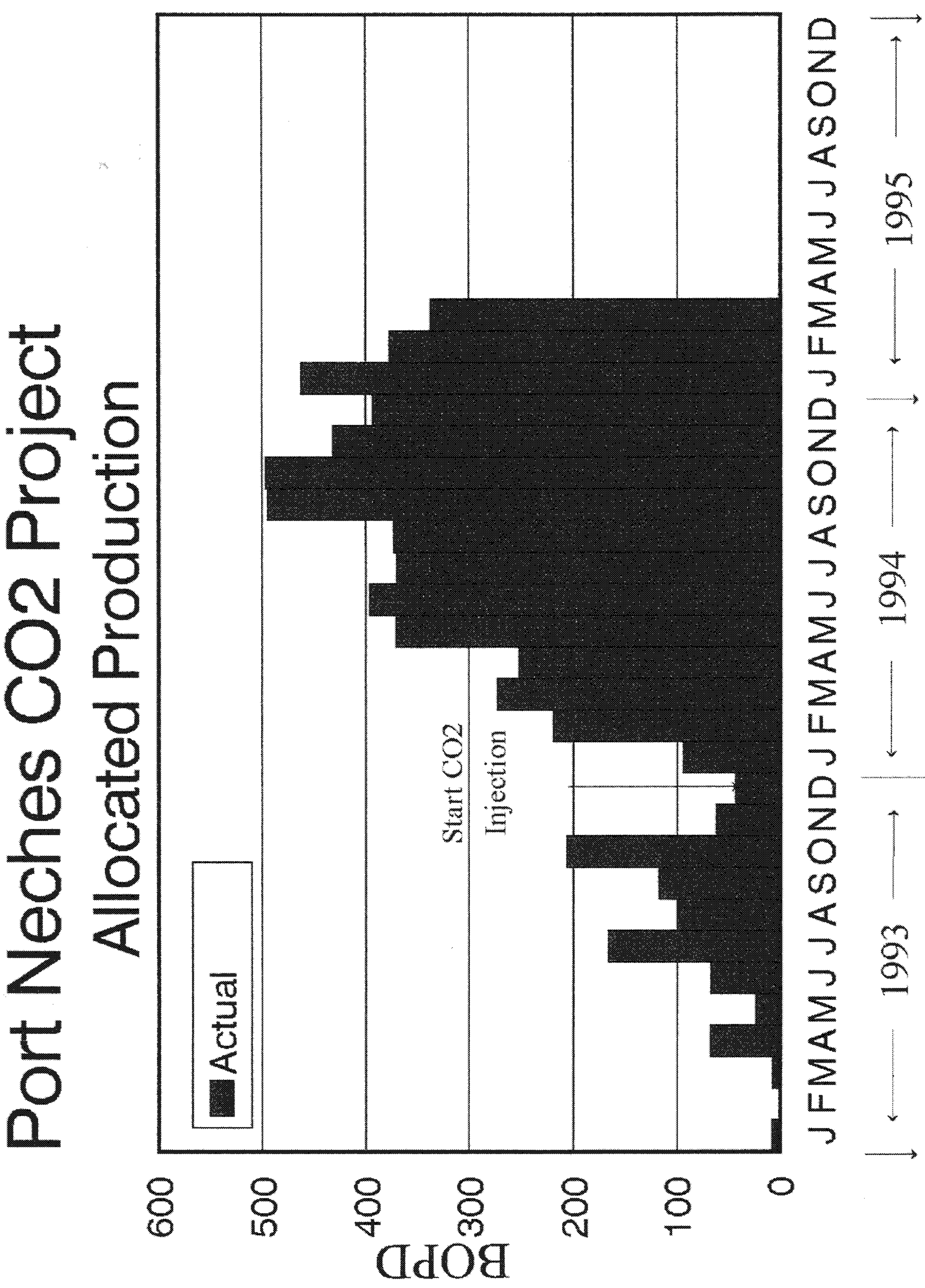
3rd Quarter (1995) Objectives

* Continue monitoring and optimizing reservoir performance.

* Evaluate the need to run production surveys in the producing and injection wells, and determine the any workover requirements.

* Workover well Kuhn #42 to the Marg Area 1 reservoir to increase production.

* Discuss with the DOE the addition of the Marg Area 3 to the project. This segment is a natural extension to the reservoir covering the Marg area 1&2. The success of this process will have a significant economic impact on the project and the program in general.



Port Neches CO2 Project
Allocated Production
Actual
Start CO2
Injection
BOPD
600
500
400
300
200
100
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1993
1994
1995

Fig 1

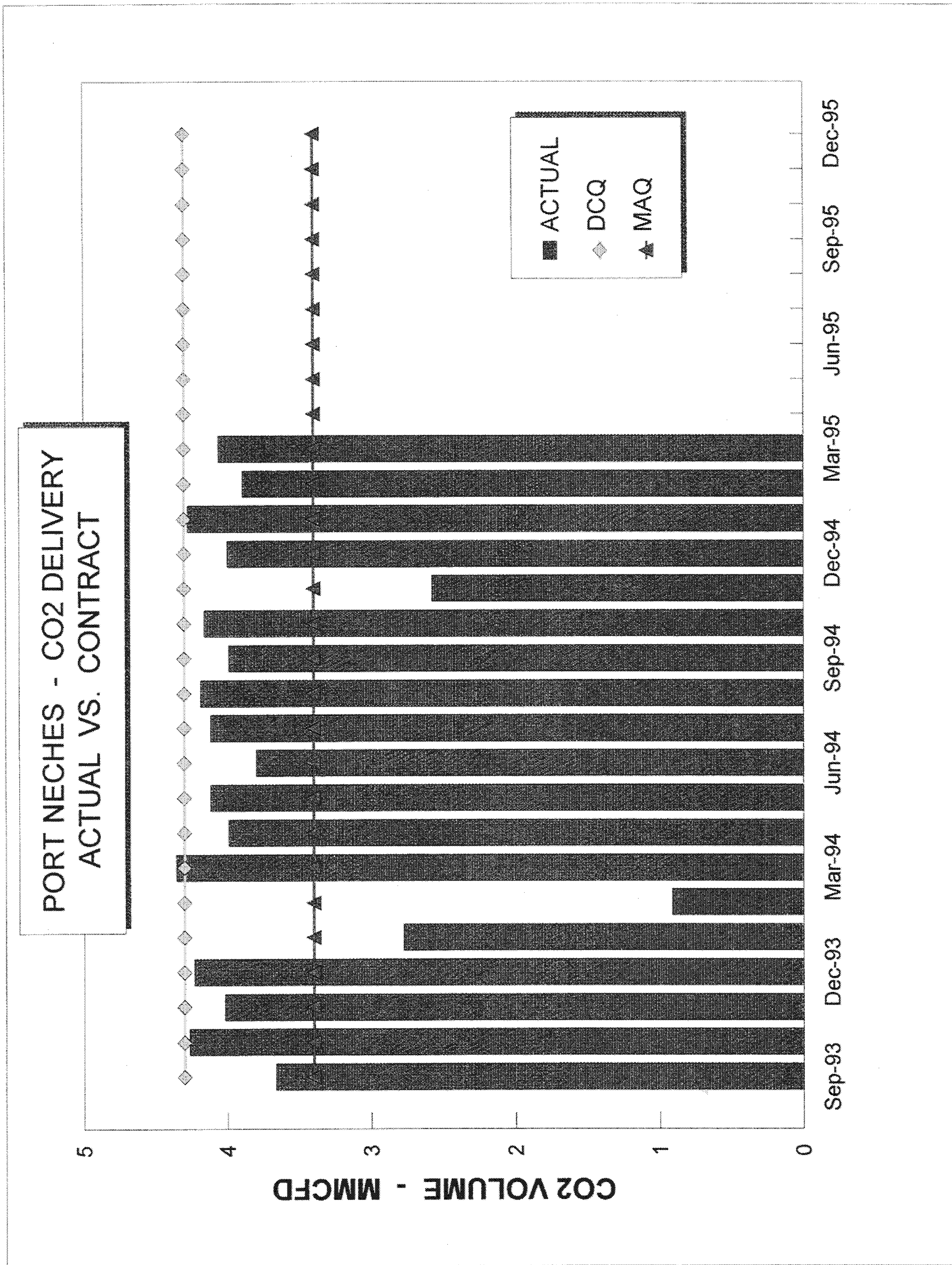
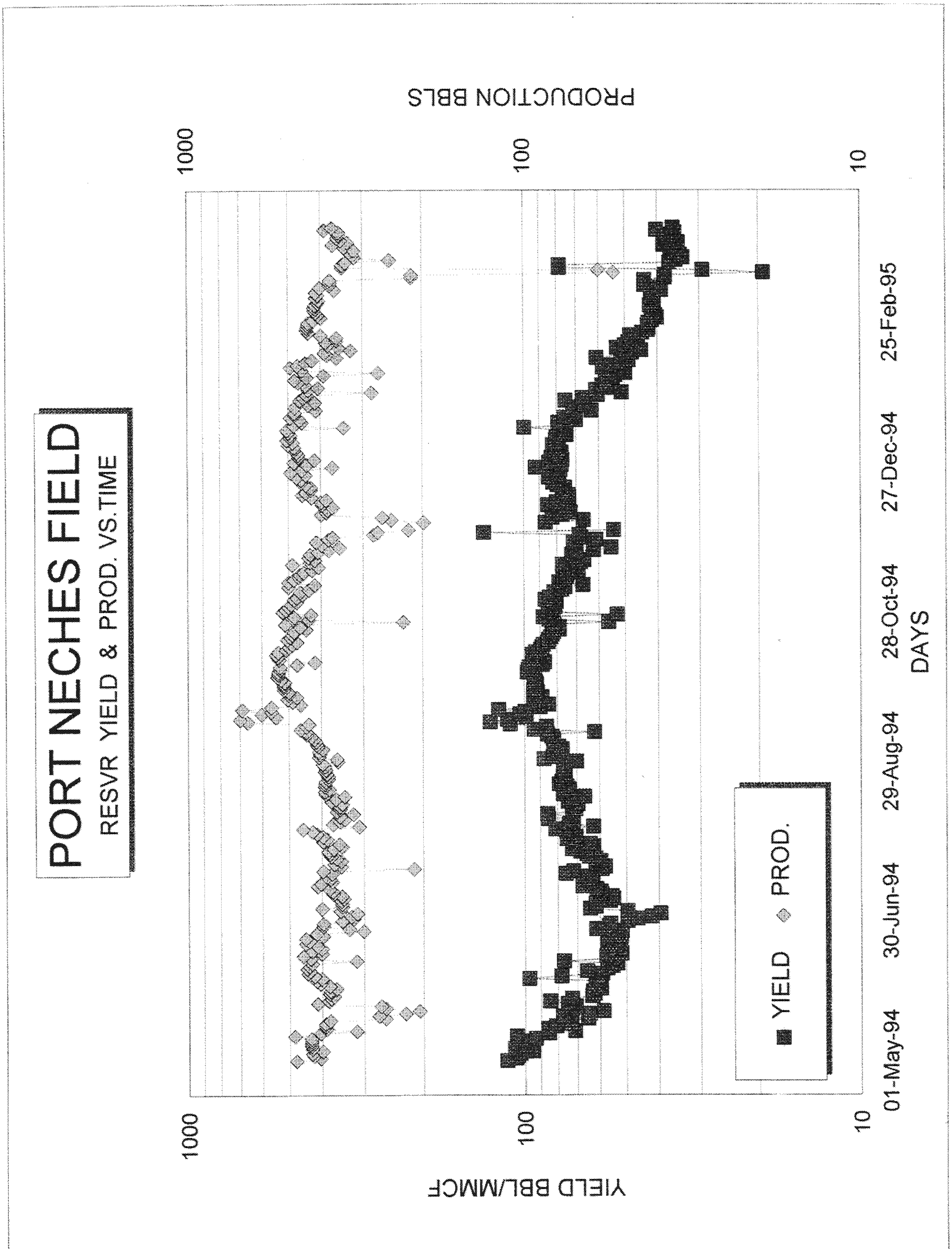

PORT NECHES - CO2 DELIVERY
ACTUAL VS. CONTRACT
CO2 VOLUME - MMCFD
ACTUAL
DCQ
MAQ
0
1
2
3
4
5
Sep-93
Dec-93
Mar-94
Jun-94
Sep-94
Dec-94
Mar-95
Jun-95
Sep-95
Dec-95

Fig 2



PORT NECHES FIELD
RESVR YIELD & PROD. VS.TIME
PRODUCTION BBLS
1000
100
10
YIELD BBL/MMCF
1000
100
10
01-May-94
30-Jun-94
29-Aug-94
28-Oct-94
27-Dec-94
25-Feb-95
DAYS
YIELD
PROD.

Fig 3

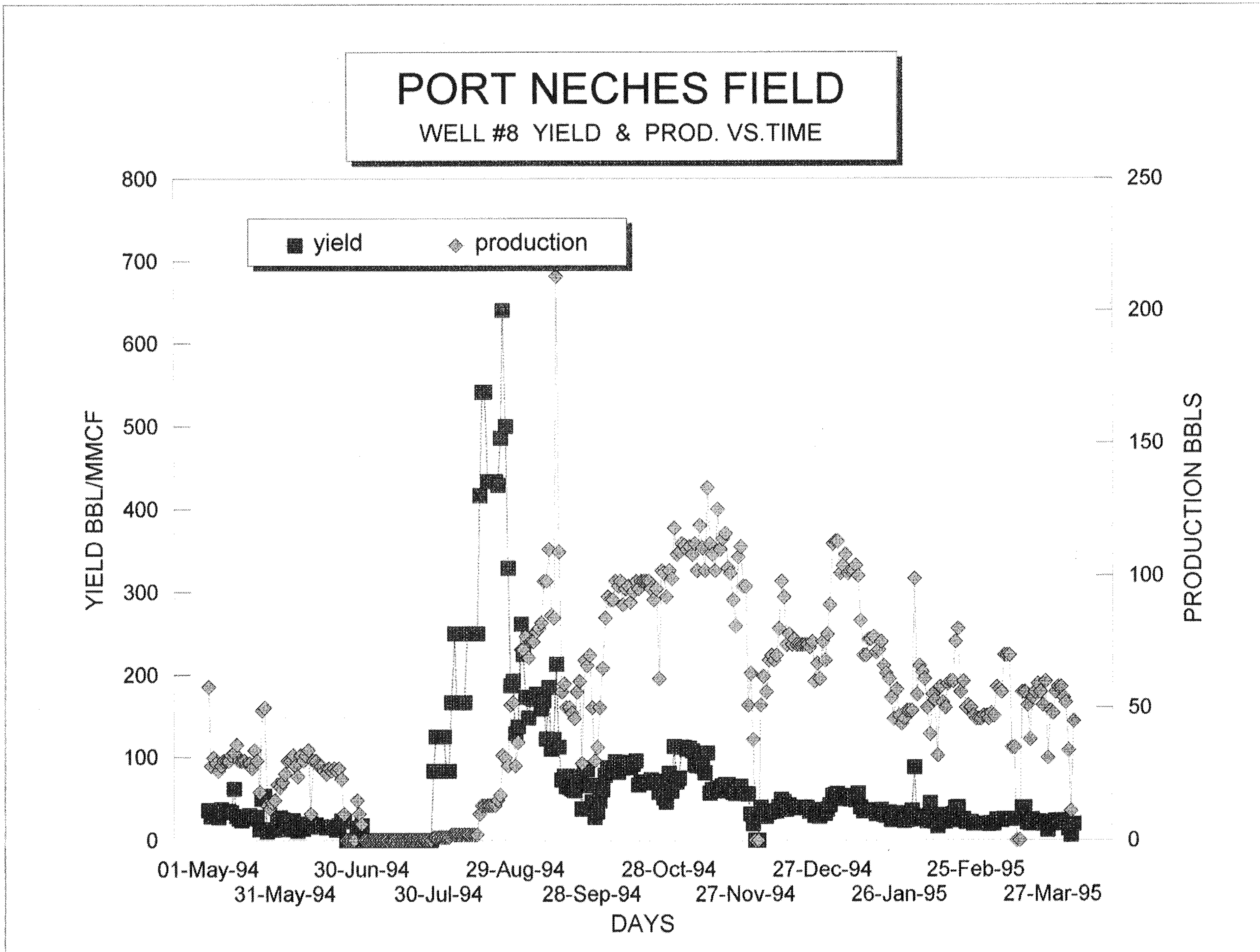

PORT NECHES FIELD
WELL #8 YIELD & PROD. VS.TIME
yield
production
YIELD BBL/MMCF
PRODUCTION BBLS
DAYS
0
100
200
300
400
500
600
700
800
50
150
250
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
26-Jan-95
25-Feb-95
27-Mar-95

Fig 4

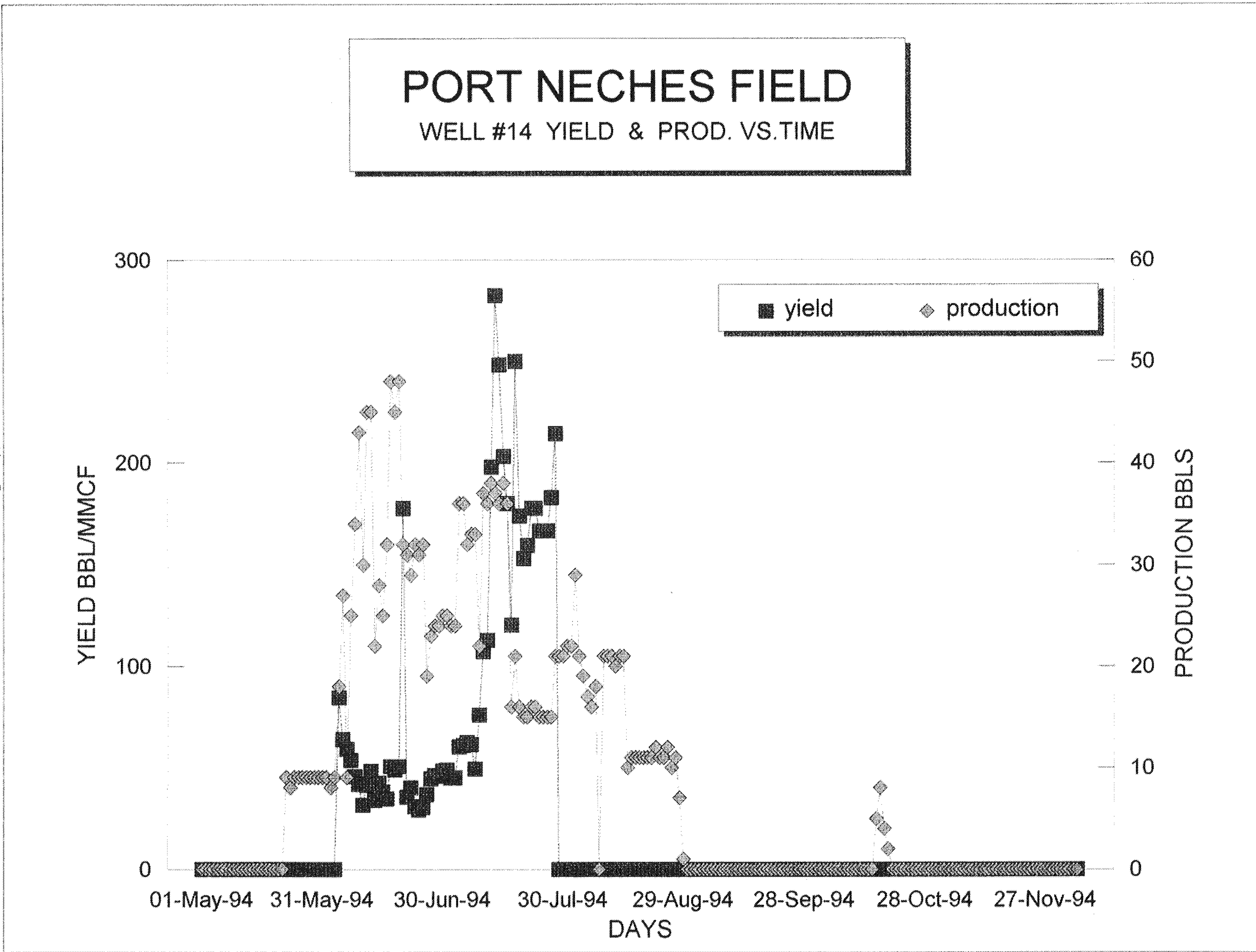
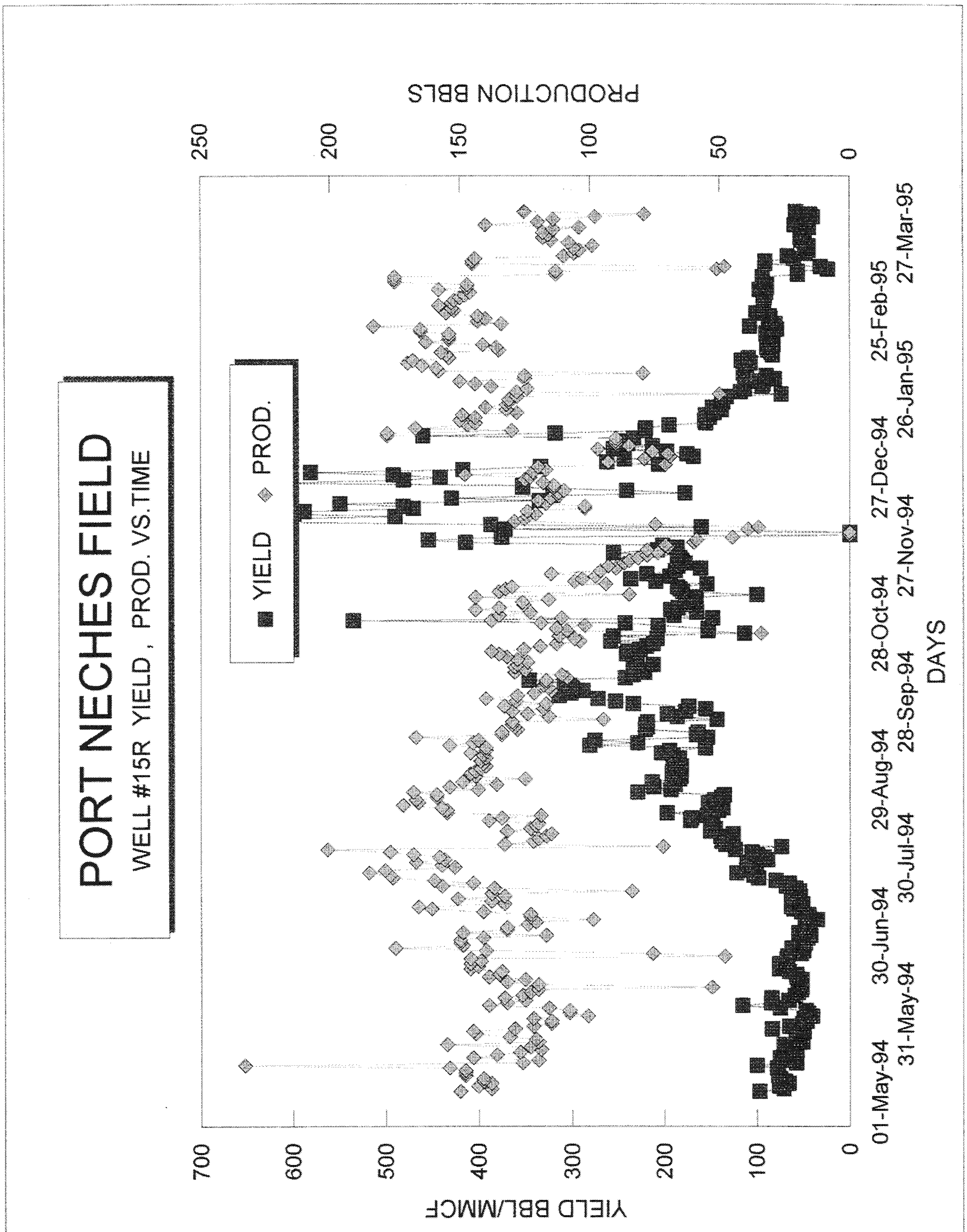

PORT NECHES FIELD
WELL #14 YIELD & PROD. VS.TIME
yield
production
YIELD BBL/MMCF
PRODUCTION BBLS
300
200
100
0
60
50
40
30
20
10
0
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
DAYS

Fig 5



PORT NECHES FIELD
WELL #15R YIELD , PROD. VS.TIME
YIELD
PROD.
PRODUCTION BBLS
YIELD BBL/MMCF
DAYS
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
26-Jan-95
25-Feb-95
27-Mar-95
0
100
200
300
400
500
600
700
0
50
100
150
200
250

Fig 6

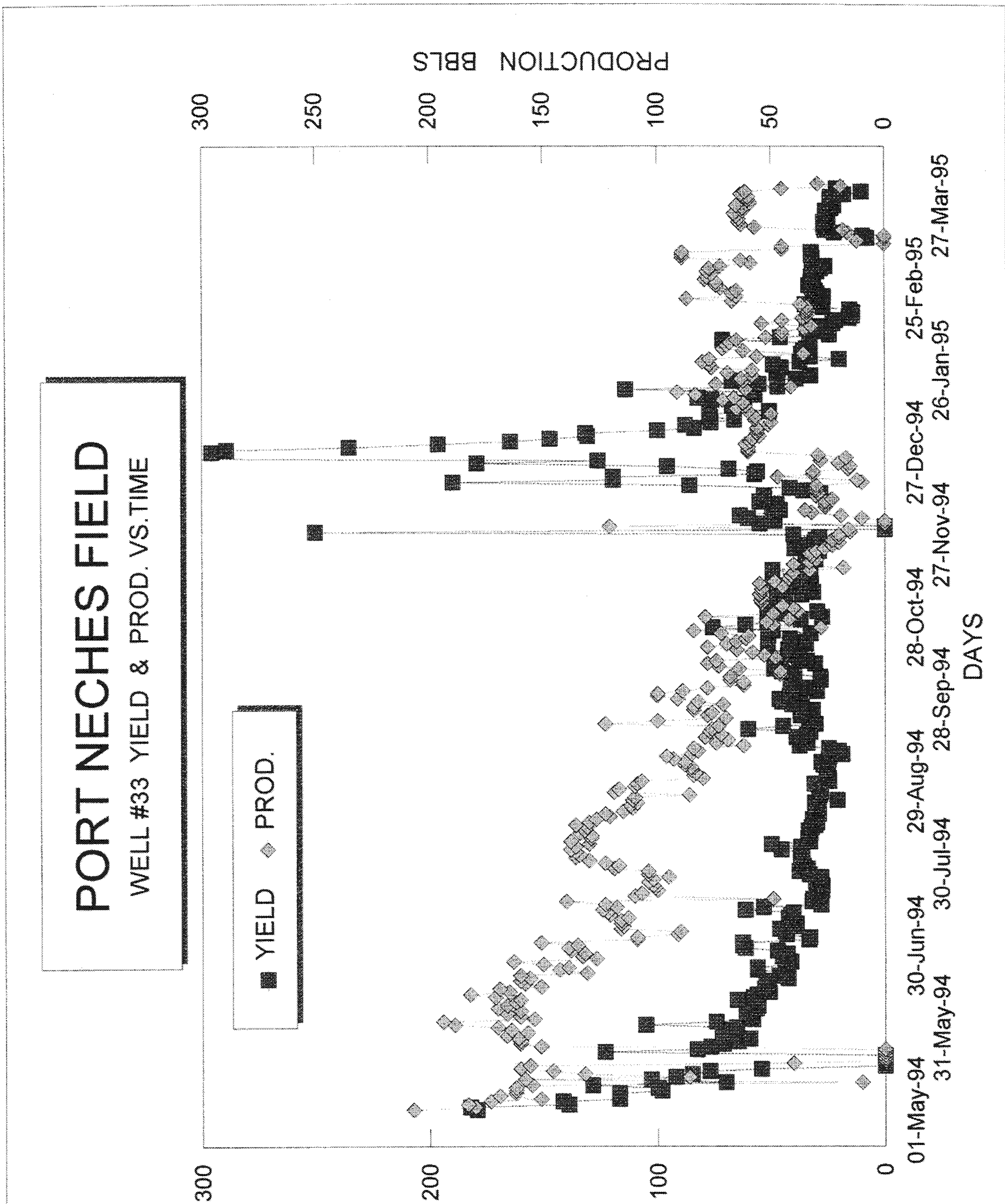

PORT NECHES FIELD
WELL #33 YIELD & PROD. VS.TIME
YIELD
PROD.
PRODUCTION BBLS
YIELD BBL/MMCF
DAYS
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
26-Jan-95
25-Feb-95
27-Mar-95
0
50
100
150
200
250
300

Fig 7

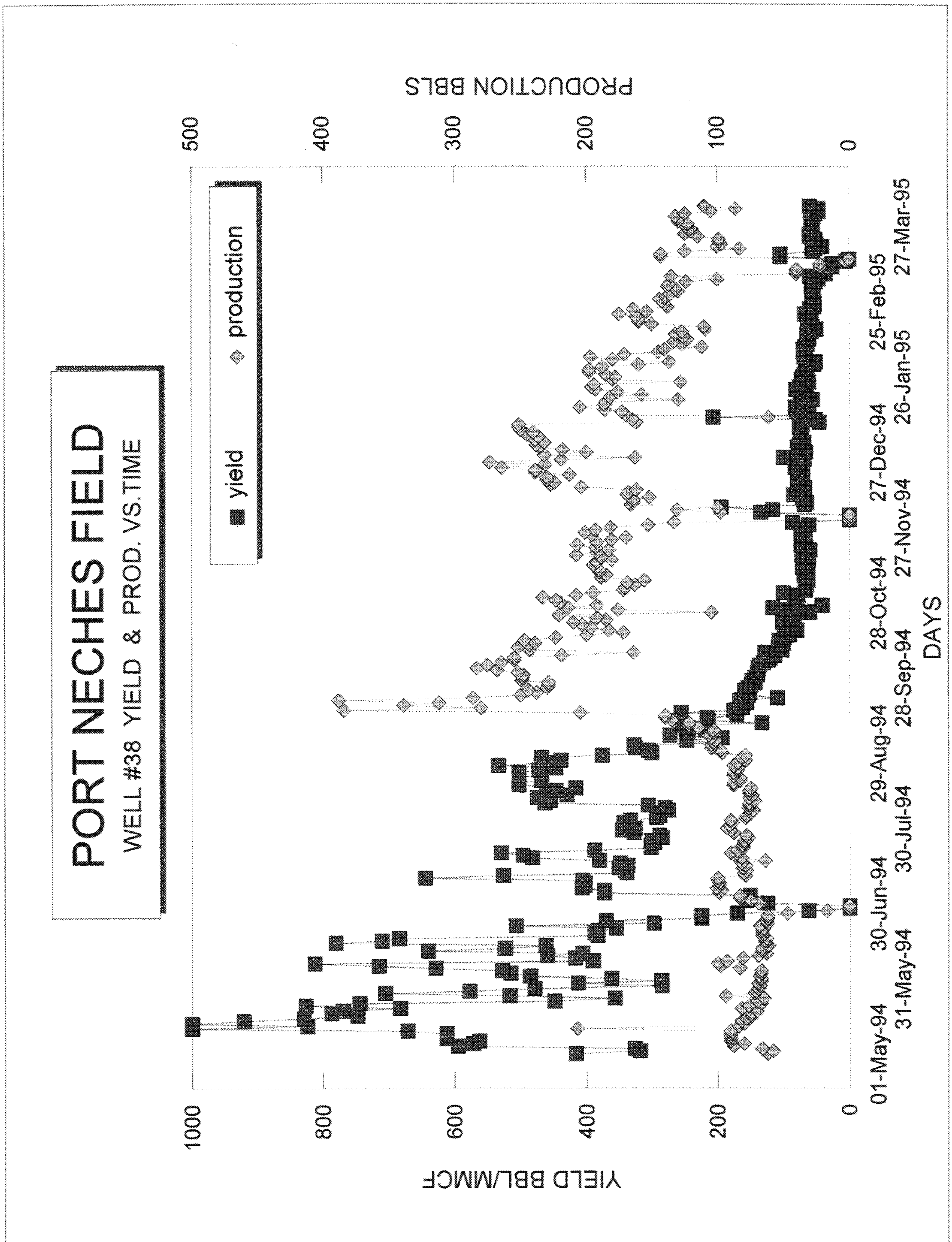

PORT NECHES FIELD
WELL #38 YIELD & PROD. VS.TIME
yield
production
YIELD BBL/MMCF
PRODUCTION BBLS
DAYS
0
200
400
600
800
1000
100
300
500
01-May-94
31-May-94
30-Jun-94
30-Jul-94
29-Aug-94
28-Sep-94
28-Oct-94
27-Nov-94
27-Dec-94
26-Jan-95
25-Feb-95
27-Mar-95

Fig 8

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted U. S. Department of Energy	2. Federal Grant or Other Identifying Number Assigned By Federal Agency DE-FC22-93BC14960	OMB Approval No. 0348-0039	Page 1	of 1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number 51-0265713	5. Recipient Account Number or Identifying Number 323037151	6. Final Report [ ] Yes [X] No	7. Basis [X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year) January 1, 1995	To: (Month, Day, Year) December 31, 1997	9. Period Covered by this Report From: (Month, Day, Year) 04-01-95	To: (Month, Day, Year) 06-30-95

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$1,042,421.36	$634,657.80	$ 1,677,079.16
b. Recipient share of outlays (64.39%)	$671,215.11	$408,656.16	$ 1,079,871.27
c. Federal share of outlays (35.61%)	$371,206.25	$226,001.64	$ 597,207.89
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$371,206.25	$226,001.64	$ 597,207.89
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$ 2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$2,613,392.75	($226,001.64)	$ 2,387,391.11

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 89.34%	c. Base $ 43,849.90	d. Total Amount $ 39,175.50	e. Federal Share $ 13,950.40

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title Sami Bou-Mikael - Project Manager	Telephone (Area code, number and extension) (504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted August 17, 1995

Standard Form 269A (REV 4-88)

Previous Editions not Usable

Prescribed by OMB Circulars A-102 and A-110

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY

SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER	2. PROGRAM/PROJECT TITLE	3. REPORTING PERIOD
DE-FC22-93BC14960	CLASS I	4/1/95 to 6/30/95

4. PARTICIPANT NAME AND ADDRESS
TEXACO EXPLORATION AND PRODUCTION
400 POYDRAS ST.
NEW ORLEANS, LA 70130

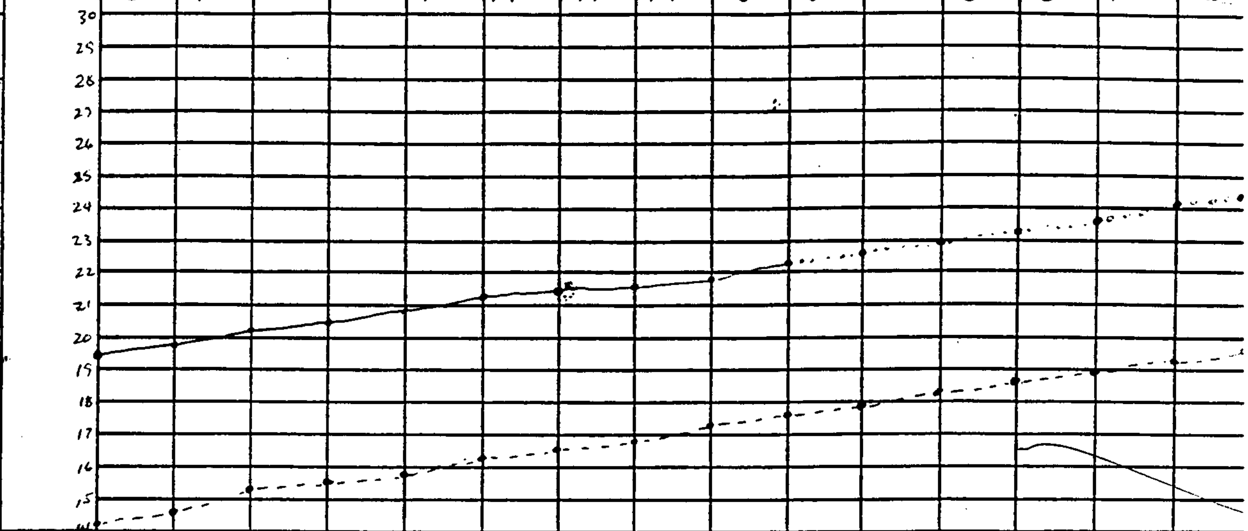
5. START DATE: 6/1/93

6. COMPLETION DATE 12/31/97

7. FY | 8. MONTHS: O N D J F M A M J J A S O N D

9. COST STATUS

a. $ Expressed in: MILLIONS
b. Budget and Reporting No. AC1510100
c. Cost Plan Date 6-23-93
d. Actual Costs Prior Years 19,722
e. Planned Costs Prior Years 14.082
f. Total Estimated Cost for Contract 10.085
g. Total Contract Value 2.985
h. Estimated Subsequent Reporting Period

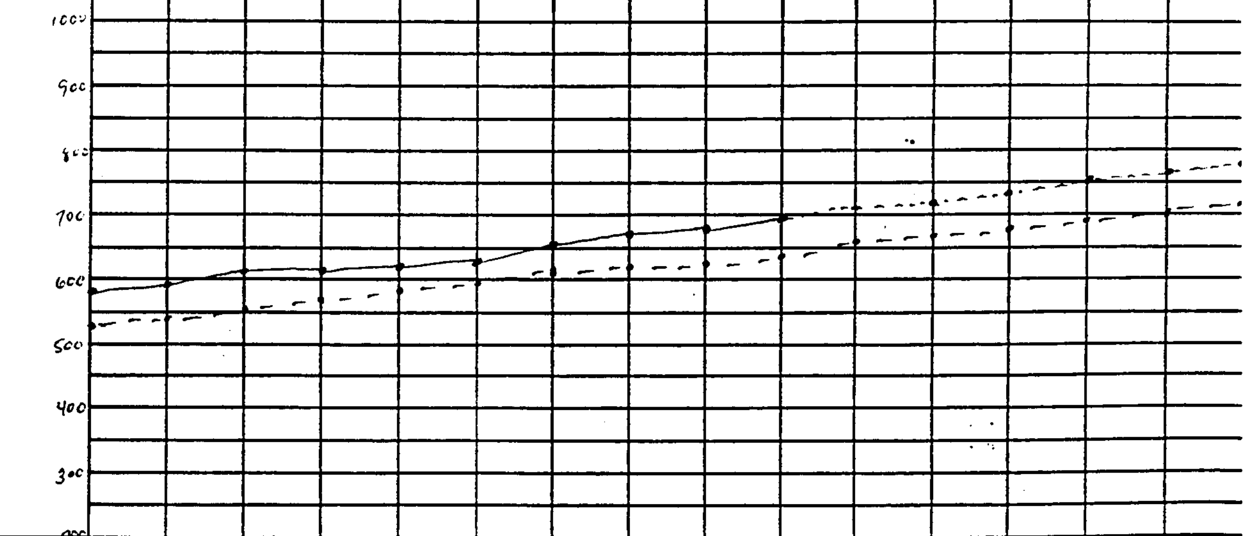


Accrued Costs	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	630	630	214	330	330	330	330	330	330	330	330	330	330	330	330
h. Actual	214	239	319	490	300	253	91	252	292						
i. Variance	416	391	<105>	<160>	30	78	239	78	38						
j. Cumulative Variance	<2142>	<1751>	<1856>	<2016>	<1986>	<1909>	<1,670>	<1592>	<1554>						

10. LABOR STATUS

a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A DIRECT LABOR
c. Planned Labor Prior Fiscal Years $530
d. Actual Labor Prior Fiscal Years $582
e. Total Estimated Labor for Contract $465
f. Total Contract Labor N/A

LEGEND
Planned: - - - - - -
Actual: ————
Projected: . . . .



Labor	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	15	15	15	13	13	13	13	13	13	13	13	13	13	13	13
h. Actual	15	11	9	5	15	18	19	8	17						
i. Variance	2	4	6	8	<2>	<5>	<6>	5	<4>						
j. Cumulative Variance	<43>	<35>	<33>	<25>	<27>	<32>	<38>	<33>	<37>						

11. MILESTONES	STATUS	COMMENTS
a.		
b.		
c.		
d.		
e.		
f.		
g.		

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir

2. REPORTING PERIOD
Apr. 1, 1995 - Jun. 30, 1995

3. IDENTIFICATION NUMBER
DE-FC22-93BC14960

4. PARTICIPANT NAME AND ADDRESS
Texaco Exploration and Production Inc.
400 Poydras St.
New Orleans, LA 70130

5. START DATE
June 1, 1993

6. COMPLETION DATE
December 31, 1997

9. DURATION: CURRENT FISCAL YEAR 1993 (Oct, Nov, Dec, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep); FY 1994 (1Q, 2Q, 3Q, 4Q); FY 1995 (1Q, 2Q, 3Q, 4Q); FY 1996; FY 1997

7. ELEMENT CODE	8. REPORTING ELEMENT	9. DURATION milestones	10. PERCENT COMPLETE a. Plan	b. Actual
1.1	Geologic & Engineering	1	100%	100%
1.2	Extraction Technology	2	100%	100%
2.1	Recording Daily Production	3, A	50%	50%
2.2	Reservoir Charac-terization	4, B, C	100%	100%
2.3	Site Operation & Field Work	D, 5, E, F	100%	100%
2.4	CO2	6	50%	50%
2.5	EH&S Monitoring & Compliance	G, H, 7, I	50%	50%
3.1	CO2 Screening Model	J, 8	100%	100%
3.2	Environmental Analysis	9	100%	100%
3.3	FDD Database & Model	K, 10	75%	75%
3.4	Technical Publications	L, 11	50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

DOE F1332.3 ATTACHMENT
(11-84)

1. TITLE **Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir**	2. REPORTING PERIOD **Apr. 1, 1995 - Jun. 30, 1995**	3. IDENTIFICATION NUMBER **DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	PROJECT 75 % COMPLETE
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	LSU WORK WILL BE COMPLETED IN SPRING, 1996
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

4. Federal grant or other identification number **DE-FC22-93BC14960**

5. Recipient's account number or identifying number [redacted]

6. Letter of credit number **NA**

7. Last payment voucher number **-**

Give total number for this period

8. Payment Vouchers credited to your account **-**

9. Treasury checks received (whether or not deposited) **0**

3. FEDERAL EMPLOYER IDENTIFICATION NO> **51-0265713**

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year) **04/01/95** TO (month,day,year) **06/30/95**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$ 0.00
	b. Letter of credit withdrawals	0.00
	c. Treasury check payments	$ 709,940.24
	d. Total receipts (Sum of lines b and c)	$ 709,940.24
	e. Total cash available (Sum of lines a and d)	$ 709,940.24
	f. Gross disbursements	$ 709,940.24
	g. Federal share of program income	0.00
	h. Net disbursements (Line f minus line g)	$ 709,940.24
	i. Adjustments of prior periods	0.00
	j. Cash on hand end of period	$ 0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$ 0.00
	l. Advances to subgrantees or subcontractors	$ 0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL

SIGNATURE

DATE REPORT SUBMITTED **08/17/95**

TYPED OR PRINTED NAME AND TITLE **Sami Bou-Mikael - Project Manager**

TELEPHONE (Area Code, Number, Extension) **(504) 593-4565**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)

Prescribed by Office of Management and Budget

Cir. No. A-110

Date: 7 April 1995

From: Zaki Bassiouni, Department Chair
Louisiana State University
Department of Petroleum Engineering

To: Sami Bou-Mikael
Texaco
PO Box 60252
New Orleans, Louisiana 70160

Re: The Port Neches Project Progress Report

Project Goal

Under the TEPI-LSU Agreement #NOS-01-93, the Louisiana State University Department of Petroleum Engineering is providing technical support for the project entitled, "Post Waterflood CO_2 Miscible Flood in Light Oil Fluvial Dominated Deltaic Reservoirs."

One of the tasks of the agreeement requires LSU to identify locations of CO_2 sources throughout the Gulf Coast region. Identifying locations is necessary because the distance to a CO_2 source is an important criterion when considering miscible flooding for a specific reservoir.

The other tasks consist mainly of screening and ranking reservoirs for their suitability to this process of enhanced oil recovery.

Work Completed

History of CO_2 Use in Enhanced Oil Recovery Efforts in Louisiana

The Department of Natural Resources (DNR) provided information on 23 CO_2 recovery projects within Louisiana. Of these 23, Texaco has 11 in five fields, Shell has three in two fields, ARCO has two (both sold to TXO) in one field, Chevron has six (two sold to Greenhill Petroleum) in three fields, and Hunt has one. All but one are in south Louisiana (Hunt's is in Olla field in LaSalle Parish). Not all of these projects are presently active. A list of the projects along with company ownerships and permit application dates is given in Table1.

C.F. Industries (now operating as Cherokee Associates) of Baton Rouge, Louisiana, has provided and transported CO_2 in liquid form to eight of the 23 projects. C.F. Industries has two CO_2 plants in Louisiana. These two facilities recover CO_2 from flue gas and from other operations, such as ammonia. Cherokee Associates has operations close to Jackson Dome (near Jackson, Mississippi) and owns part of the Choctaw pipeline. Liquid Carbonics company was listed as a commercial source of CO_2 for one of Chevron's projects in Timbalier Bay. For its project in Olla field, Hunt obtained CO_2 by unknown means from Black Lake field. Shell, for its project in Week's Island field, used CO_2 via pipeline from Jackson Dome.

Jackson Dome (Shell) Pipeline

Jackson Dome is the only major naturally occurring source of CO_2 in the south. Shell operates a pipeline that runs from Jackson Dome to Week's Island field. The pipeline has two sections: a 20 inch and a 10 inch. The 20-inch pipeline crosses from Mississippi into Louisiana in

St. Helena Parish and continues across St. Helena, Livingston, East Baton Rouge, Ascension, and Iberville parishes. A site just northeast of Pierre Part serves as a pumping station where the 20-inch and 10-inch pipelines connect. The 10-inch pipeline, then, starts from Pierre Part, crosses Assumption, St. Martin, St. Mary, and Iberia parishes, and terminates at Week's Island field. The last 16 miles of this pipeline were leased and are temporarily being used for hydrocarbon transportation. The remaining northern portion is still in use for transport of a small amount of CO_2 to Shell projects.

Mr. Don Hebert of the Pipeline Division of the Office of Conservation supplied the name of the Shell contact, Mr. Bruce Blome (713-241-2702). Mr. Blome said that the line is available for tap-ins and has a large transportation capacity . He suggested that Mr. Jim Gross (713-241-3888), the builder of the line for Shell, be contacted for specifics.

CO_2 Sources/Providers in Louisiana

A complete list of CO_2 sources and providers was compiled through personal interviews and by reviewing a brochure entitled, "A Visitor's Guide to the Louisiana Chemical Industry," published by the Louisiana Chemical Association in January 1993. Additional providers/sources include those identifed by Texaco. Some potential commercial sources/providers of CO_2 were also found from a Sara Title-3 database provided by Dr. John Pine of Louisiana State University. A list of identified CO_2 providers is given in Table 2.

Preliminary Ranking of Reservoirs Suitable for Post Waterflood CO_2 Miscible Flooding

The major task of the project is to identify Louisiana reservoirs that are suitable for the application of the post waterflood CO_2 miscible flood process. The Department of Natural Resources also provided information on 501 reservoirs that have been either waterflooded or studied to be waterflooded within Louisiana. An abundant source of information on these reservoirs was found in DNR's "Waterflood Application Questionnaire Sheets" and the "Secondary Recovery and Pressure Maintenance Annual Data Sheets." Additional information was obtained through the Department of Natural Resources PARS computer database. A list of fields with at least one waterflooded reservoir is given in Table 3.

A spreadsheet of the information collected for the waterflood reservoirs was developed, in the form of Lotus 1-2-3, for screening and ranking the reservoirs for tertiary CO_2 flooding. The data contained within the spreadsheet is listed in Table 4. Using the spreadsheet, we found inconsistencies in the data. These inconsistencies are believed to have been caused by a change of field operators and a change in personnel filing reports and undocumented updates to the reservoirs' characterizations by operators. Primary missing and erroneous data included information on pressure, reservoir area, production, temperature, and other miscellaneous items, such as present total wells, depth, thickness, porosity, and API gravity.

Very little pressure information is available at the Louisiana Department of Conservation. Missing temperature data was estimated from depth whenever possible. Any other missing information that could not be obtained from DNR was also estimated whenever possible.

Using the available data, we performed a preliminary ranking of reservoirs based on the technical feasibility of the process. Fields that contain the top 100 technically ranked reservoirs, at this stage in the study, are listed in Table 5.

Tertiary CO_2 Enhanced Oil Recovery Prospect Map

To illustrate the proximity of the waterflooded reservoirs to CO_2 sources, we modified, with their permission, Pennwell Publishing Company's map, "Pipelines of Louisiana," copyright 1986. To the map, we added the following information:

- fields with at least one waterflooded reservoir;
- plant sources of CO_2;
- fields with at least one reservoir in the initial top 100 technical ranking; and
- the location of the Shell CO_2 pipeline.

Two copies of the modified map are attached.

Work Planned

Work planned for the next reporting period includes contacting Hunt to determine if Black Lake field has a sufficient quantity of CO_2 for use. Also planned for the next reporting period is to use information from the CO_2 spreadsheet to complete the screening and ranking of all waterflooded reservoirs for their suitability for tertiary CO_2 flooding. Reservoirs for which we do not have sufficient information to make estimations will be eliminated from the list as we screen them.

TABLE 1

CO_2 PROJECTS IDENTIFIED FROM OFFICE OF CONSERVATION*

Texaco:	Lake Barre (LB UP MS RD SU) - 3/84
	West Cote Blanche Bay (W CBB 14 RBX SU) - 3/84
	Bayou Sale (BS St. Mary RDS SU) - 3/84
	Paradis (PAR Paradis RTSU) - 3/84
	Lafitte (LFT 8900 RMKA SU) - 5/84
	Paradis (PAR LWR 9000 RM SU) - 1/80
	Paradis (PAR 8 RA SU) - 1/80
	Paradis (PAR 9500 RC7 SU) - 4/89
	Paradis (16 SD RAB-1) - 2/89
	Paradis (PAR PZ RU SU) - 5/90
	Paradis (PAR 10000 RU SU) - 5/90
ARCO:	Jeanerette (JEN Q RA VU) - 7/84, [currently owned by TXO]
	Jeanerette (JEN UR RA VU) - 7/84, [currently owned by TXO]
Shell:	White Castle (WC MW RA SU) - 3/86
	Weeks Island (R RA SU) - 9/86
	Weeks Island (S RA SU) - 9/86
Chevron:	Timbalier Bay (TB 4900 RBASU) - 1/87, [currently owned by Greenhill Petroleum]
	Quarantine Bay (QB 4 RC SU) - 8/81
	Timbalier Bay (TB S-2B RA SU) - 9/83, [currently owned by Greenhill Petroleum]
	Baymarchand (BLK 2 2500' A) - 7/90
	Baymarchand (BLK 2 3150'-3200' A) - 7/90
	Baymarchand (BLK 2 3400' RB) - 3/91
Hunt:	Olla (OL 2800 Wilcox RA SU) - 10/82

* DNR EOR contact: Mr. Todd Keating, 504-342-5540

TABLE 2
CO_2 PROVIDERS IN LOUISIANA

AGRICO CHEMICAL COMPANY/FREEPORT-MCMORAN
9959 La. 18
St. James, La. 70086
(504) 473-4271
Scott Shean

Chemicals manufactured: sulfuric acid, phosphoric acid, diammonium and monoammonium phosphates, urea.
Consumer uses: fertilizer.

AIR PRODUCTS AND CHEMICALS, INC.
14700 Intracoastal Drive
New Orleans, La. 70129
(504) 254-1590
William Greer

Chemicals manufactured: Ammonia, carbon dioxide, hydrogen.
Consumer uses: fertilizer (urea products), dry ice, fuel for space shuttle program.

AMERICAN CYANAMID
10800 River Road
Westwego, La. 70094-2040
(504) 431-6436
Jim Dutcher

Chemicals manufactured: acrylonitrile, aminonitrile, acrlamae, methylmethancralate, acetonitrile, melamine, sulfuric acid, ammonia.
Consumer uses: acrylite, synthetic fibers, ABS plastics.

AMPRO FERTILIZER INC.
P.O. Box 392
Donaldsonville, La. 70346
(504) 473-3976
Bobby K. Shackelford

Chemicals manufactured: anhydrous ammonia
Consumer uses: fertilizer

CF INDUSTRIES
P.O. Box 468
Donaldsonville, La. 70346
(504) 473-8291
Gene T. Lewis

Chemicals manufactured: ammonia, urea ammonia nitrate, urea.
Consumer uses: fertilizer.

DOW CHEMICAL USA
P.O. Box 150
Plaquemine, La. 70765-0150
(504) 389-8236

Chemicals manufactured: caustic, chlorine, chlor-alkali, cellulose, chlorinated methanes, chlorinated polyethylene/glycol ethers, glycol I and II, light hydrocarbon II and III, poly A & B, C, solvents/EDC, vinyl II (over 50 basic chemicals).
Consumer uses: soaps, bleaches, food additives, cosmetics, shampoos, pharmaceuticals, automotive hoses, roofing, brake fluid, antifreeze, adhesives, film, trash bags, Tupperware, pipe, diaper liners, wall paper, herbicides, aerosols, Teflon, solvents, silicones, detergents, milk carton coatings, Handi-wrap, Saran-wrap, ice bags, housewares, margarine tubs.

FARMLAND INDUSTRIES, INC.
P.O. Box 438
Pollock, La. 71467
(318) 765-3574
William White

Chemicals manufactured: anhydrous ammonia
Consumer uses: fertilizer

MONSANTO COMPANY
P.O. Box 174
Luling, La. 70070
(504) 785-3259
Tim Gustafson

Chemicals manufactured: ammonia, activated chlorine/cynauric (ACL/CYA), phosphorous trichloride (PCL3), disodiumiminodisidicacid (DSIDA), APAP (Acetaminophen), Glyphosate, herbicide.
Consumer uses: nylon, chlorine for swimming pools, bleaches, aspirin substitute, herbicides.

OCCIDENTAL CHEMICAL CORPORATION

7377 Hwy. 3214
Convent, La. 70723
(504) 562-9201

Chemicals manufactured: chlorine, caustic soda, ethylene dichlorides (EDC), hydrogen.
Consumer uses: PVC plastics - EDC, water purification, chlorine.

OLIN CORPORATION

P.O. Box 52137
Shreveport, La. 71135
(318) 797-2595
E.E. Warren

Chemicals manufactured: sulfuric acid.
Consumer uses: gasoline, paper, batteries, fertilizer, water purification.

PIONEER CHLOR ALKALI COMPANY INC.

P.O. Box 23
St. Gabriel, La. 70776
(504) 642-1882
Benny L. Bennett

Chemicals manufactured: chlorine, caustic, hydrogen.
Consumer uses: polyvinyl chloride, soap, bleach, pesticides, water treatment chemicals.

TRIAD CHEMICAL

P.O. Box 310
Donaldsonville, La. 70346
(504) 473-9231
Tomm Torr

Chemicals manufactured: ammonia, urea.
Consumer uses: fertilizers.

VULCAN CHEMICAL COMPANY
P.O. Box 227
Geismar, La. 70734
(504) 473-5003
John Waupsh

Chemicals manufactured: chlorine, caustic soda, methyl chloride, chloroform, carbon tetrachloride, perchloroethylene, EDC, methyl chloroform, muriatic acid, hydrogen.
Consumer uses: refrigerants, silicones, dry cleaning, equipment cleaning solvents, food industry (soda pop), pulp and paper.

CONVENT PLANT
Convent, La.

UNION CARBIDE CORP.
P.O. Box 50
Hahnville, La. 70057

INTERNATIONAL MINERALS & CHEMICAL CORP.
Sterlington, La. 71280

FORMOSA PLASTICS CORPORATION
P.O. Box 271
Baton Rouge, La. 70821
(504) 356-3341
Alden L. Andre

Chemicals manufactured: chlorine, caustic soda, ethylene dichlorides (EDC), vinyl chlorides monomer (VCM), polyvinyl chloride (PVC).
Consumer uses: PVC pipe, pool liners, pondliners, shower curtains, tablecloths, raincoats, book binders, air mattresses, waterbeds, etc.

PPG INDUSTRIES INC.
P.O. Box 15
Lake Charles, La. 70602
(318) 491-4500
Tom G. Brown

Chemicals manufactured: chlorine, caustic soda, vinyl chloride monomer, silicas products, chlorinated solvents.
Consumer uses: vinyl plastic, water treatment, paper, aluminum.

TABLE 3
FIELDS WITH AT LEAST ONE WATERFLOODED RESERVOIR

Avery Island
Bancroft
Bay Marchand
Bay St. Elaine
Bayou Choctaw
Bayou des Glaise
Bayou Fordoche
Bayou Middle Fork
Bayou Sale
Belle Isle
Bellevue
Big Creek
Black Bayou
Bossier
Buckhorn
Bull Bayou
Bully Camp
Burrwood
Caddo (Jeems Bayou)
Caddo-Pine Island
Caillou Island
Carterville
Catahoula Lake
Cecelis
Chemard Lake
Clovelly
Cotton Valley
Cut Off
Dave Haas
Delhi
Delta Farms
Delta Duck Club
Deltabridge
DeSoto - Red River
DeSoto - Red River (Bull Bayou)
Dog Lake
Duck Lake
Dykesville
East Hackberry
East Larto Lake
East Longville
Erath
Eugene Island Block 18
Eugene Island Block 19
Frisco
Garden City
Garden Island Bay
Good Hope
Grand Bay
Grand Ilse Block 18
Grand Lake
Greenwood-Waskom
Grogan
Haynesville
Hester
Holly
Hurricane Creek
Iota
Iowa
Jefferson Davis
Jennings
Killens Ferry
Klondike
Lafitte
Lake Barre
Lake Enfermer
Lake Hatch
Lake Hermitage
Lake Mongulois
Lake Pelto
Lake Salvador
Lake Washington
Larose
Larto Lake
Leeville
Lisbon
Little Lake
Little Temple
Livingston
Livonia
Lockhart Crossing
Locust Ridge
Longville
Main Pass Block 35
Main Pass Block 41
Main Pass Block 69
Mamou
Manila Village
Mira
Naberton (Bull Bayou)
Napoleonville
Nebo-Hemphill
Newlight
North Burtville
North Cankton
North Missionary Lake
North Shongaloo-Red Rock
Northeast Lisbon
Olla
Opelousas
Opelousas
Ora
Panther Creek
Paradis
Patterson
Perry Point
Pine Island
Pleasant Hill
Plumb Bob
Port Barre
Potash
Quarantine Bay
Red River-Bull Bayou
Redland
Rodessa
S.E. Manila Village
Saline Lake
Section 28
Sentell Field
Shongaloo
Shongaloo-Pettet, W Seg
Siegen
Simpson Lake
South Bayou Mallet
South Black Bayou
South Pass Block 24
South Pass Block 27
Southeast Pass
Southeast Pass & S. Pass Blk. 6
Southwest Lisbon
Starks
Sulphur Mines
Ten Mile Bayou
Tepetate
Timbalier Bay
Valentine
Vatican
Venice
Ville Platte
West Bay
West Cote Blanche Bay
West Delta Block 83
West Delta Block 84
West Hackberry
West Lake Verret
West Lisbon
West Tepetate
West White Lake
White Castle

TABLE 4
DATA CONTAINED WITHIN CO_2 SPREADSHEET

operator	Swc
field	Sor
b-codes	orig. So
LUW	RP
parish	Pentanes+
reservoir	date pre-app
Distance to source (mi.)	Np pre-app
Nearest Source	Gp pre-app
Pipeline Distance (mi)	Wp pre-app
1st .comp	Np prior to inj.
wellupd	Gp prior inj.
dateupd	Wp prior inj.
total active&siwells	Np since inj.
total gas wells	Gp since inj.
total inj. wells	Wp since inj.
P&A	Cum Np
total wells	Cum Gp
orig area	Cum Wp
type struct	Cum Wi
orig res psi	EOOIP
date orp	M
pres res psi	GOR trend
date prp	WOR trend
orig drive	Pres dec
pres drive	Well Density
avg depth	pres est So
avg H O&G	BOPD
avg H oil	MCFD
area oil	BWPD
avg H gas	Type Inj. H20
area gas	API
avg por	C5+ MW
avg Kh	Temp (f)
avg Kv	Date of MRP
cp	MMP
sat psi	sat gor

TABLE 5
FIELDS WITH RESERVOIRS IN TOP 100 TECHNICAL RANK

Bay Marchand Block 2
Black Bayou
Bully Camp
Burrwood
Caillou Island
Clovelly
Dave Haas
Delta Duck Club
Dog Lake
Eugene Island Block 18
Frisco
Garden City
Garden Island Bay
Grand Bay
Hurricane Creek
Lake Barre
Lake Hatch
Leeville
Little Lake
Livingston
Livonia
Lockhart Crossing
Main Pass Block 69
Manila Village
Plumb Bob
Port Barre
Quarantine Bay
South Pass Block 24
South Pass Block 27
Southeast Pass
Tepetate
Timbalier Bay
Valentine
Vatican
Ville Platte
West Bay
West Cote Blanche
West Delta Block 83
West White Lake

POST WATERFLOOD CO_2 MISCIBLE FLOOD IN LIGHT OIL
FLUVIAL DOMINATED DELTAIC RESERVOIRS"

"DE-FC22-93BC14960"
TECHNICAL PROGRESS REPORT

3rd QUARTER, 1995.

EXECUTIVE SUMMARY

Production from the Marg Area 1 at Port Neches is averaging 337 BOPD for this quarter. The production drop is due to fluctuation in both GOR and BS&W on various producing wells, low water injectivity in the reservoir and shut-in one producing well to perform a workover to replace a failed gravel pack setting. Coil tubing work was performed on 2 injection wells in order to resume injection of water and CO_2 in the reservoir. The Marg Area 2 did not respond favorably to CO_2 injection in the Kuhn #6 well. For this reason Texaco will not pursue any further development of this section of the reservoir due mainly to low target reserves. Instead Texaco will reallocate the money to a new Marg segment (Marg Area 3) in order to test a new process that will utilize the CO_2 to accelerate the primary production rates and reduce cycle time. Also the process should reduce water disposal cost, cash lifting cost, operating cost and increase the NPV of the reserves.

3rd QUARTER (1995) OBJECTIVES

* Monitor and optimize reservoir performance.

The reservoir production during this quarter declined from 392 BOPD to about 337 BOPD due to mechanical problems in two major producers in the reservoir (Kuhn #38 and Kuhn #15R). The gravel pack settings in the wells have failed as evidenced by the surface chokes and by subsequent wireline runs that indicated some sand fill inside the screen. Texaco is planning to workover the wells to correct this problem. Additionally, Texaco is planning to bring a coiled tubing rig to the field to clean out the injection wells in order to increase the water and CO_2 injection rates to maintain reservoir pressure. A second WAG cycle is planned in an attempt to reduce the total GOR and improve the oil production rate.

* Workover well Kuhn #42 to plug it down to the Marg Area 1 to increase the reservoir production.

The workover for well Kuhn #42 was postponed until September 1995 due to well utilization in the C-1 reservoir. The well will be plugged down as soon as it becomes available. This well is anticipated to recover additional oil from the reservoir that can not be recovered otherwise. However, it may become necessary to workover the injection well Kuhn #36 to reinstate injection in this part of the reservoir.

* Discuss with the DOE the addition of the Marg Area 3 to the project.

The Marg Area 3 segment is a natural extension to the rest of the Marg reservoir. The proposed project to test the CO_2 utilization to improve the primary production rates was based on the high production rates encountered in the Marg Area 1 reservoir during tertiary production as compared to primary production. Similar observations were noticed in other CO_2 floods. The Marg Area 3 project was presented to the DOE personnel in Bartlesville and will be incorporated into the current project area. All other contract conditions will remain unaffected. The project will have a significant contribution in determining the need to begin CO_2 flooding early in the life of a particular reservoir while the primary oil bank is available. This test will evaluate the economic impact of combining the tertiary and primary production while reducing the operating cost due water disposal, artificial lift and cycle time.

DISCUSSION OF RESULTS - FIELD OPERATIONS.

Reservoir pressure difference between well Kuhn #6 and the rest of the reservoir confirmed the separation between Area 1 and Area 2 of the reservoir. The Stratamodel built for this reservoir suggested similar conclusions. For this reason Texaco recommended the following actions:

* Cancel the drilling of the Polk B#39 injection well, in Area 2 of the reservoir.

* Expend the project to a new area that can impact the project economics positively.

* Workover Kuhn #42 in Area 1 to increase the reservoir production.

CO_2 purchases from Cardox was temporarily interrupted during the 3rd quarter. However, The daily CO_2 purchases averaged 1850 MCFD. CO_2 purchases are illustrated in figure 2. The following is a list of the most recent well tests taken during the month of June 1995 for the producing wells:

Kuhn #15R	172 BOPD,	636 BWPD,	1645 MMCFD,	17 CHOKE.
Kuhn #38	88 BOPD,	818 BWPD,	1427 MMCFD,	22 CHOKE.
KUHN #33	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.
STARK #8	46 BOPD,	636 BWPD,	2134 MMCFD,	28 CHOKE.
KUHN #6	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.
KUHN #14	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.
POLK #B5	-- BOPD,	-- BWPD,	-- MMCFD,	-- CHOKE.

DISCUSSION OF RESULTS - TECHNOLOGY TRANSFER.

Texaco and SAIC are planning to submit two papers for consideration to the annual SPE/DOE IOR symposium to be held in Tulsa in April of 1996. LSU is also planning on submitting a separate SPE paper.

4th Quarter (1995) Objectives

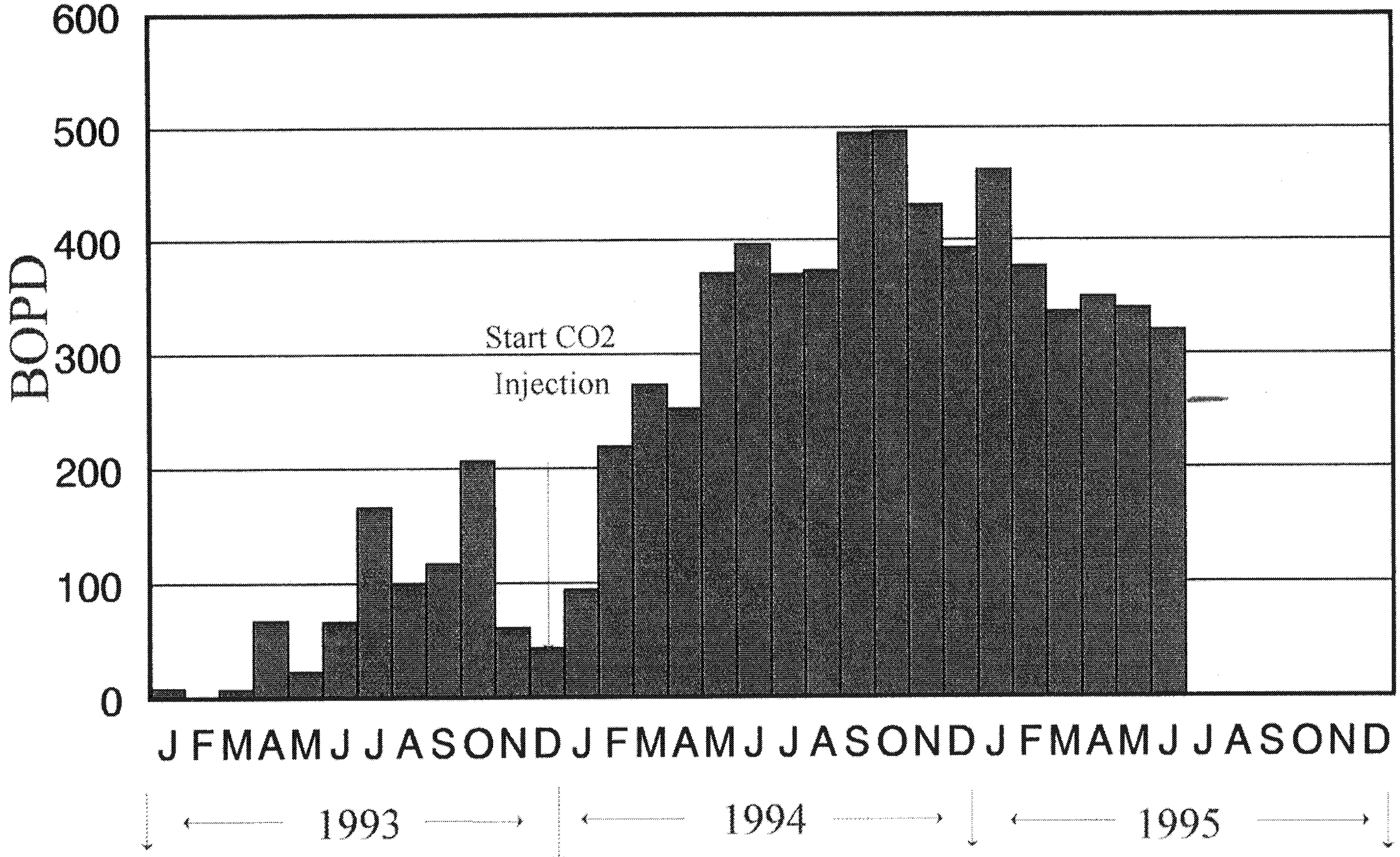
* Continue monitoring and optimizing reservoir performance.

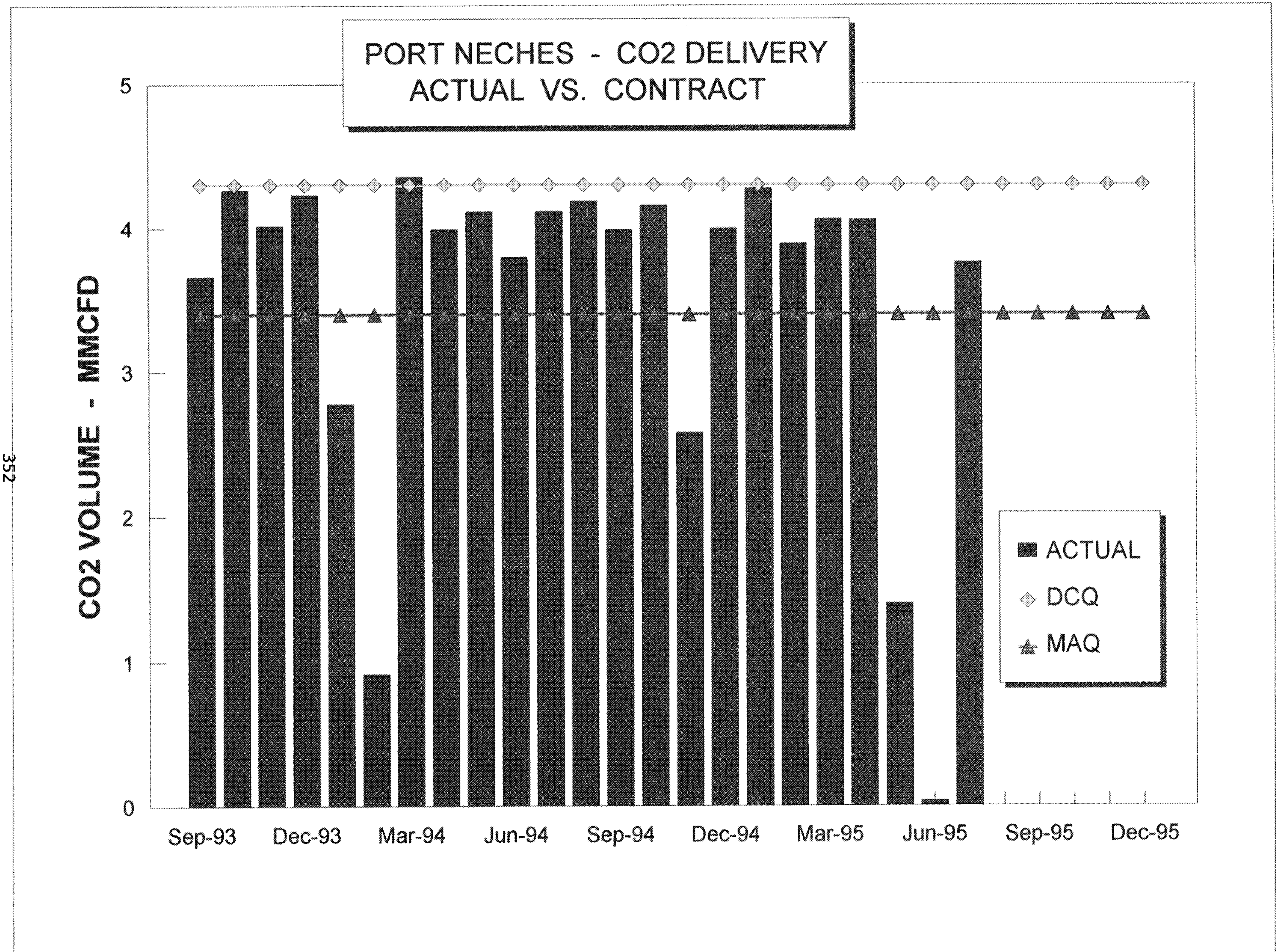
* Workover well Kuhn #42 to the Marg Area 1 reservoir to increase production.

* Drill Polk B#39 as a CO_2 injection well to the Marg Area 3, after a successful completion of the discovery well Polk B#40 as a producer in the same reservoir. Upon well completion commence CO_2 injection by the OWC.

Port Neches CO2 Project

Allocated Production




PORT NECHES - CO2 DELIVERY
ACTUAL VS. CONTRACT
CO2 VOLUME - MMCFD
5
4
3
2
1
0
Sep-93
Dec-93
Mar-94
Jun-94
Sep-94
Dec-94
Mar-95
Jun-95
Sep-95
Dec-95
ACTUAL
DCQ
MAQ

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No.	Page	of
U. S. Department of Energy	DE-FC22-93BC14960	0348-0039	1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	323037151	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
January 1, 1995	December 31, 1997	07-01-95	09-30-95

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$1,677,079.16	$477,722.06	$2,154,801.22
b. Recipient share of outlays (64.39%)	$1,079,871.27	$307,605.23	$1,387,476.51
c. Federal share of outlays (35.61%)	$597,207.89	$170,116.83	$767,324.71
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$597,207.89	$170,116.83	$767,324.71
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$2,387,391.11	($170,116.83)	$2,217,274.29

11. Indirect Expense (Labor)	a. Type of Rate (Place "X" in appropriate box) [X] Provisional	[ ] Predetermined	[ ] Final	[ ] Fixed
	b. Rate 89.34%	c. Base $11,823.26	d. Total Amount $10,562.90	e. Federal Share $3,761.45

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

13. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

Typed or Printed Name and Title	Telephone (Area code, number and extension)
Sami Bou-Mikael - Project Manager	(504) 593-4565
Signature of Authorized Certifying Official	Date Report Submitted
	August 17, 1995

Standard Form 269A (REV 4-88)

Previous Editions not Usable

Prescribed by OMB Circulars A-102 and A-110

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted **U. S. Department of Energy**

2. RECIPIENT ORGANIZATION

Name **Texaco Exploration and Production Inc.**

Number and Street **400 Poydras St.**

City, State and Zip Code: **New Orleans, Louisiana 70130**

4. Federal grant or other identification number **DE-FC22-93BC14960**

5. Recipient's account number or identifying number [redacted]

6. Letter of credit number **NA**

7. Last payment voucher number **-**

Give total number for this period

8. Payment Vouchers credited to your account **-**

9. Treasury checks received (whether or not deposited) **0**

3. FEDERAL EMPLOYER IDENTIFICATION NO> **51-0265713**

10. PERIOD COVERED BY THIS REPORT

FROM (month,day,year) **07/01/95** TO (month,day,year) **09/30/95**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$0.00
	d. Total receipts (Sum of lines b and c)	$0.00
	e. Total cash available (Sum of lines a and d)	$0.00
	f. Gross disbursements	$0.00
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$0.00
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL

SIGNATURE

DATE REPORT SUBMITTED **11/15/95**

TYPED OR PRINTED NAME AND TITLE **Sami Bou-Mikael - Project Manager**

TELEPHONE (Area Code, Number, Extension) **(504) 593-4565**

THIS SPACE FOR PRIVATE USE

POST WATERFLOOD CO_2 MISCIBLE FLOOD IN LIGHT OIL
FLUVIAL DOMINATED DELTAIC RESERVOIRS"

"DE-FC22-93BC14960"
TECHNICAL PROGRESS REPORT

4th QUARTER, 1995.

EXECUTIVE SUMMARY

Production from the Marg Area 1 at Port Neches is averaging 222 BOPD for this quarter. The production drop is due in part to mechanical problems and to poor sweep efficiency caused by water blockage that prevented the CO_2 from contacting new residual oil deeper in the reservoir. Alternating water and gas injection assisted to some extent in maintaining oil production and improved the reservoir yield by reducing the gas production. A workover was performed on well Kuhn #38 to correct failed gravel pack setting. Production from the well was restored to 60 BOPD. Plugging of the injection wells continue to be a problem, reducing the injection rate in critical areas of the reservoir, near well Kuhn #15R.

Texaco drilled the well Polk B #39 to The Marg Area 3 reservoir to gain structural position based on the 3D seismic, and found the sand present as anticipated. However, the sand did not have any hydrocarbon accumulation. For this reason, Texaco will abandon testing the idea of utilizing CO_2 to accelerate the primary production rate and reduce water production and primary production cycle time, in the reservoir.

4th QUARTER (1995) OBJECTIVES

* Continue monitoring and optimizing reservoir performance.

The reservoir production during this quarter continued to decline due to mechanical problems in the injection and producing wells. The low reservoir sweep efficiency has been impeded by what appear to be water blockage from water injected initially to raise the reservoir pressure to the MMP, prior to CO2 injection. Since the water is an incompressible fluid injected in a closed reservoir, it can not be pushed back into an aquifer and therefore it must be produced before the injected CO_2 can contact the maximum amount of residual oil available in the reservoir. The sweep area will be minimized to a narrow strip between the injection and producing wells where the recovery is high initially until the narrow strip of oil is completely swept.

The producing wells will start to experience premature breakthrough of injection fluids. This was observed in at least 3 of the producing wells: Kuhn #33, Stark #8 and Kuhn #14. The reservoir production for this quarter, shown in Figure 1, averaged 222 BOPD mainly from three wells Kuhn #15R, Stark #8 and Kuhn #38. During this period, a workover was performed to correct failed gravel pack setting on well Kuhn #38. The workover was completed and we were able to restore production from the well to a rate of 60 BOPD. Another workover was performed on well Kuhn #42 to plug it down to the Marg Area 1 reservoir. The workover will be discussed later in this report.

A second WAG cycle was initiated during this period by converting well Kuhn #17 to water injection and well Stark #7 to CO_2 injection. Recently, we also converted the horizontal Marg Area #1H well to water injection and Kuhn #17 to CO_2 injection after Stark #7 well quit taking any CO_2. A reservoir map is shown in the attached figure.

<u>* Workover well Kuhn #42 to plug it down to the Marg Area 1 to increase the reservoir production.</u>

The workover for well Kuhn #42 was postponed until September 1995 due to well utilization in the C-1 reservoir. The strategy is to plug down the well to the Marg Area 1 to improve the reservoir sweep efficiency and recover additional oil that could not have been recovered otherwise. As a result of the workover the well is currently producing water as indicated by the CHHL (TDT). Later we anticipate to see some hydrocarbon production displaced by the CO_2 injection in the Marg Area 1. After a three months testing period if we did not see any CO_2 in the well, we will evaluate converting it to an injector to displace the stagnant oil from this isolated area toward the center of the reservoir, to be recovered by wells Kuhn #15R and Kuhn #14. Well Kuhn #36 may require a workover to resume CO_2 injection in this section of the reservoir.

<u>* Drill Polk B#39 as a CO_2 injection well to the Marg Area 3 after a successful completion of the discovery well Polk B#40 as a producer in the same reservoir. Upon well completion commence CO_2 injection by the OWC.</u>

As stated earlier, Texaco drilled the discovery well Polk B#39 and found the sand to be wet. For this reason, Texaco will abandon testing the idea of utilizing CO_2 to accelerate the primary production rate and reduce water production and primary production cycle time, in the reservoir. We will be evaluating other reservoirs in the Port Neches Field to perform the above test. This test will allow us to measure the economic impact of combining the tertiary and primary production utilizing CO_2.

DISCUSSION OF RESULTS - FIELD OPERATIONS

Texaco is in the process of completing an update of the reservoir model using the Stratamodel to improve the reservoir description, and tertiary production information. Texaco Exploration and Producing Technology Division (EPTD) in Houston carry out this model update. The model should better quantify the tertiary oil recovery volume remaining to be produced from the project and the CO_2 volume required recovering the oil. The separation between the main northern portion and the southern portion of Area 1, confirm the presence of two different drive mechanisms in the reservoir that will reduce the total recovery significantly. Texaco's experience in other Gulf Coast reservoirs conclude that economical CO_2 project should only be conducted in pressure depleted reservoirs, where the oil saturation are at or above the Minimum Displaceable Oil Saturation (> 10% of the S_{or}), and where the gas channels will allow the CO_2 to penetrate deeper to contact the oil and recover it. Texaco resumed CO_2 purchases from Cardox during the 4th quarter of the 1995 fiscal year. However, in light of the recent decline of oil production from the project, Texaco is evaluating the need for additional CO_2 volume required to recover the remaining tertiary oil. The reservoir model will be utilized to make this decision. The daily CO_2 purchases illustrated in figure 3 averaged 2636 MCFD. The following is a list of the most recent well tests taken during the month of September 1995 for the producing wells:

Kuhn #15R	167 BOPD,	714 BWPD,	1360 MCFD,	22 CHOKE.
Kuhn #38	58 BOPD,	390 BWPD,	1279 MCFD,	20 CHOKE.
Stark #8	16 BOPD,	394 BWPD,	349 MCFD,	28 CHOKE.

DISCUSSION OF RESULTS - TECHNOLOGY TRANSFER.

Texaco will be presenting a paper at the up coming SPE/DOE tenth IOR symposium to be held in April of 1996. The paper is entitled: "A new analytical method to evaluate, predict and improve CO_2 flood performance in sandstone reservoirs".

1st Quarter (1996) Objectives

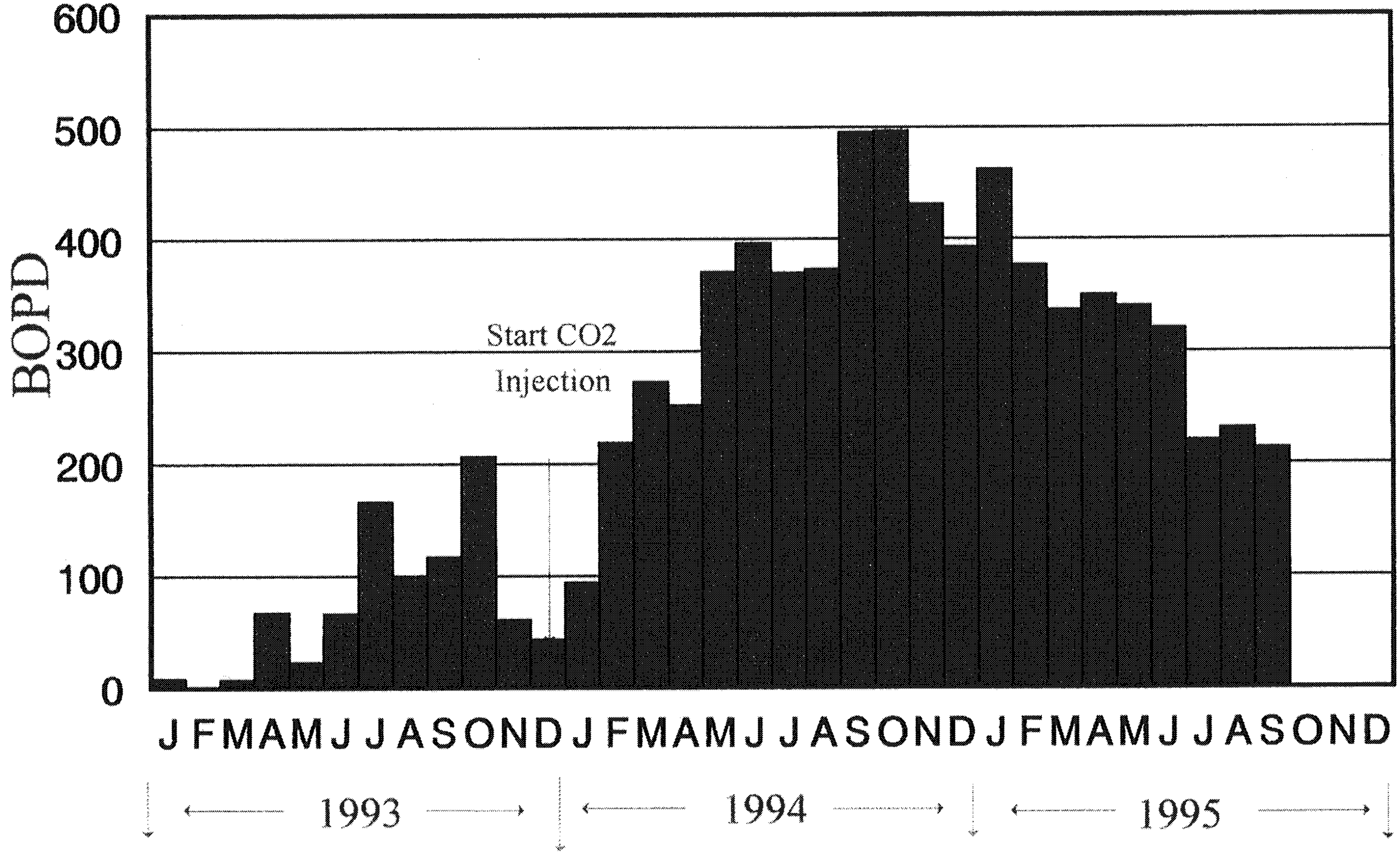
* Continue monitoring and optimizing reservoir performance.

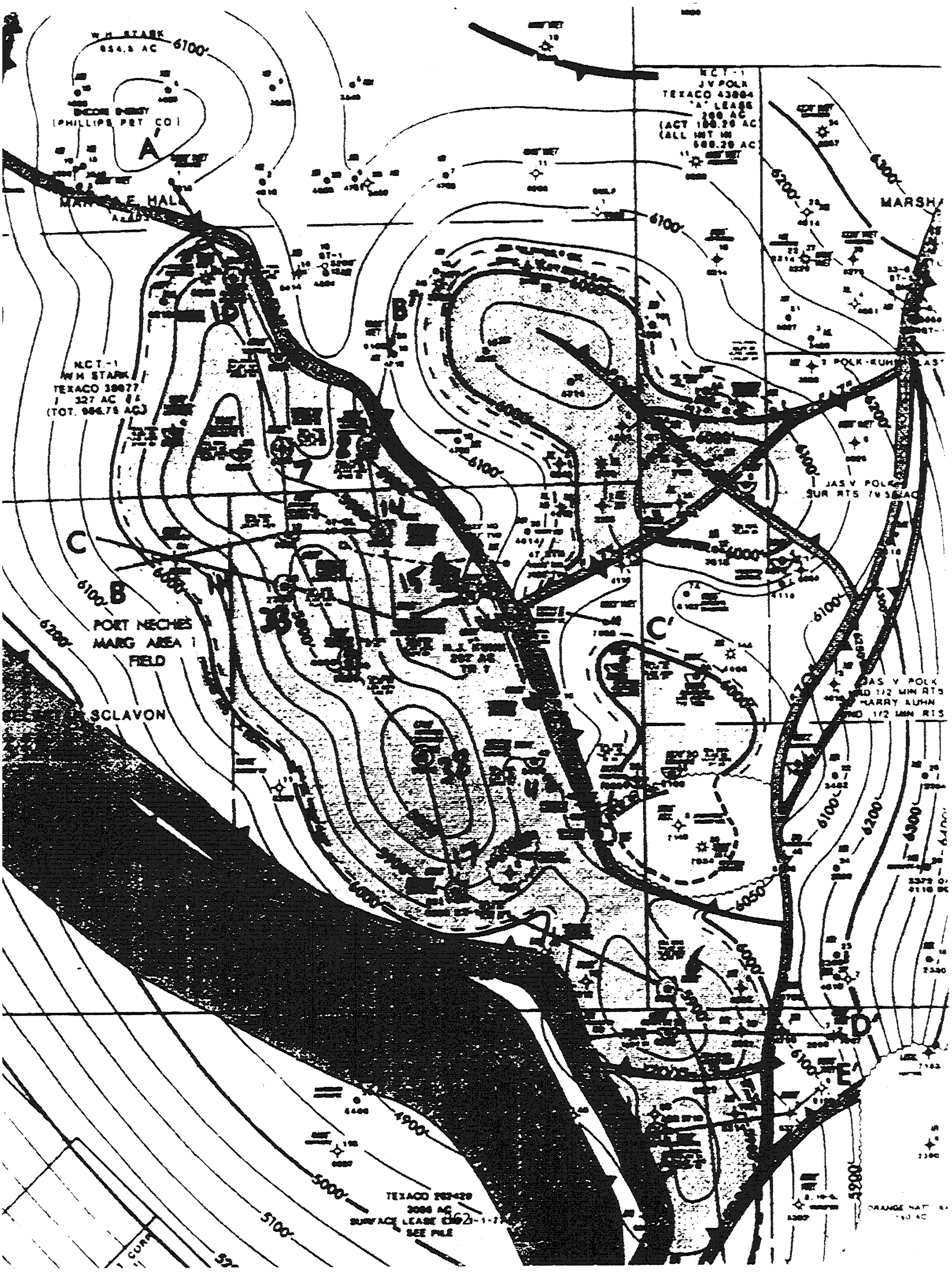
* Evaluate the need for additional CO_2 purchases.

* Update the reservoir model.

Port Neches CO2 Project

Allocated Production




W H STARK
6100'
A'
PHILLIPS PET CO
N.C.T.-1
J V POLK
TEXACO 43804
"A" LEASE
MARSH
B'
N.C.T.-1
W H STARK
TEXACO 38077
6100'
6000'
C
6100'
B
6200'
PORT NECHES
MARG AREA 1
FIELD
SCLAVON
C'
JAS V POLK
6100'
6200'
6300'
6050'
6000'
D'
E'
4900'
5000'
5100'
TEXACO 262420
3086 AC
SURFACE LEASE
SEE FILE
4900'
362

FINANCIAL STATUS REPORT
(Short Form)

1. Federal Agency and Organizational Element to Which Report is submitted	2. Federal Grant or Other Identifying Number Assigned By Federal Agency	OMB Approval No.	Page	of
U. S. Department of Energy	DE-FC22-93BC14960	0348-0039	1	1 pages

3. Reciepient Organization (Name and complete address, including ZIP code)

Texaco Exploration and Production Inc. 400 Poydras St. New Orleans, LA 70130

4. Employer Identification Number	5. Recipient Account Number or Identifying Number	6. Final Report	7. Basis
51-0265713	323037151	[ ] Yes [X] No	[X] Cash [X] Accrual

8. Funding/Grant Period (See Instuctions) From: (Month, Day, Year)	To: (Month, Day, Year)	9. Period Covered by this Report From: (Month, Day, Year)	To: (Month, Day, Year)
January 1, 1995	December 31, 1997	10-01-95	12-31-95

10 Transactions	I Previously Reported	II This Period	III Cumulative
a. Total outlays	$2,606,756.28	$851,411.27	$3,458,167.55
b. Recipient share of outlays (64.39%)	$1,678,490.37	$548,223.72	$2,226,714.09
c. Federal share of outlays (35.61%)	$928,265.91	$303,187.55	$1,231,453.46
d. Total unliquidated obligations	0.00	0.00	0.00
e. Recipient share of unliquidated obligations	0.00	0.00	0.00
f. Federal share of unliquidated obligations	0.00	0.00	0.00
g. Total Federal share (Sum of lines c and f)	$928,265.91	$303,187.55	$1,231,453.46
h. Total Federal funds authorized for this funding period	$2,984,599.00	$0.00	$2,984,599.00
i. Unobligated balance of Federal funds (Line h minus line g)	$2,056,333.09	($303,187.55)	$1,753,145.54

11. Indirect Expense (Labor)

a. Type of Rate (Place "X" in appropriate box): [X] Provisional [ ] Predetermined [ ] Final [ ] Fixed

b. Rate	c. Base	d. Total Amount	e. Federal Share
89.34%	$27,134.72	$24,242.16	$8,632.63

12. Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation

NOTE: This report reflects a one time change to report total cash outlay including advances instead of actual charges.

3. Certification: I certify to the best of my knowledge and belief that this report is correct and complete and that all outlays and unliquidated obligations are for the purposes set forth in the award documents.

'yped or Printed Name and Title	Telephone (Area code, number and extension)
Sami Bou-Mikael - Project Manager	(504) 593-4565
ignature of Authorized Certifying Official	Date Report Submitted: Jan. 19, 1996

'evious Editions not Usable

Standard Form 269A (REV 4-88)
Prescribed by OMB Circulars A-102 and A-110

file: DOERPT12.WK4

DOE F1332.2
(11-84)

U.S. DEPARTMENT OF ENERGY
SUMMARY REPORT

FORM APPROVED
OMB NO. 1901-1400

1. IDENTIFICATION NUMBER	2. PROGRAM/PROJECT TITLE	3. REPORTING PERIOD
DE-FC22-93BC14960	CLASS I	10-01-95 thru 12-31-95

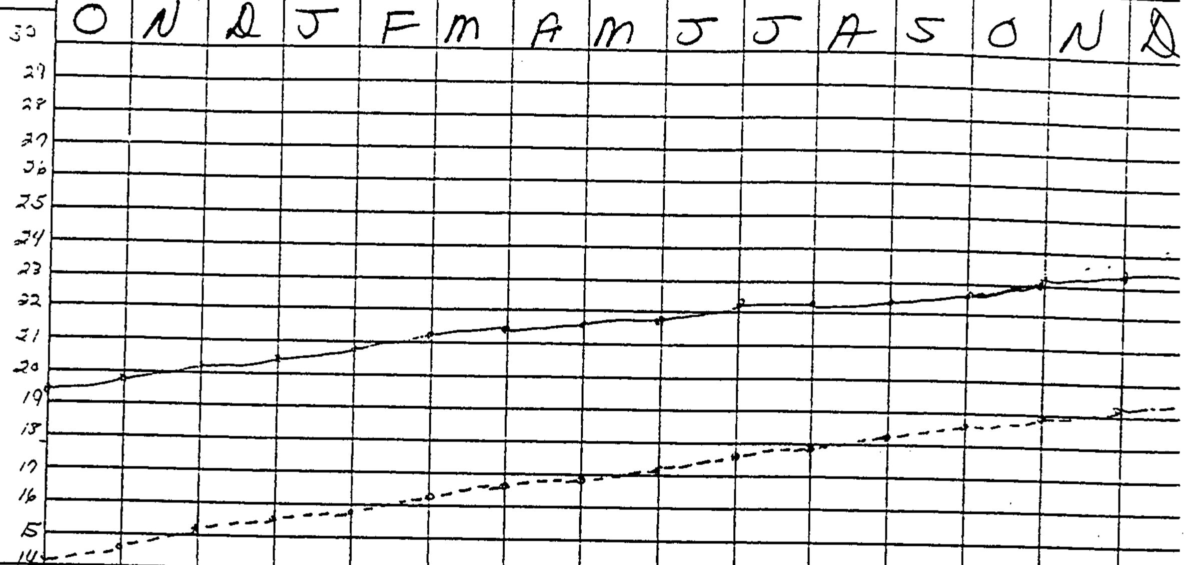
4. PARTICIPANT NAME AND ADDRESS
TEXACO Exploration & Production Inc.
400 Poydras St.
New Orleans, LA. 70130

5. START DATE: 6-1-93

6. COMPLETION DATE: 12-31-97

7. FY — 8. MONTHS: O N D J F M A M J J A S O N D

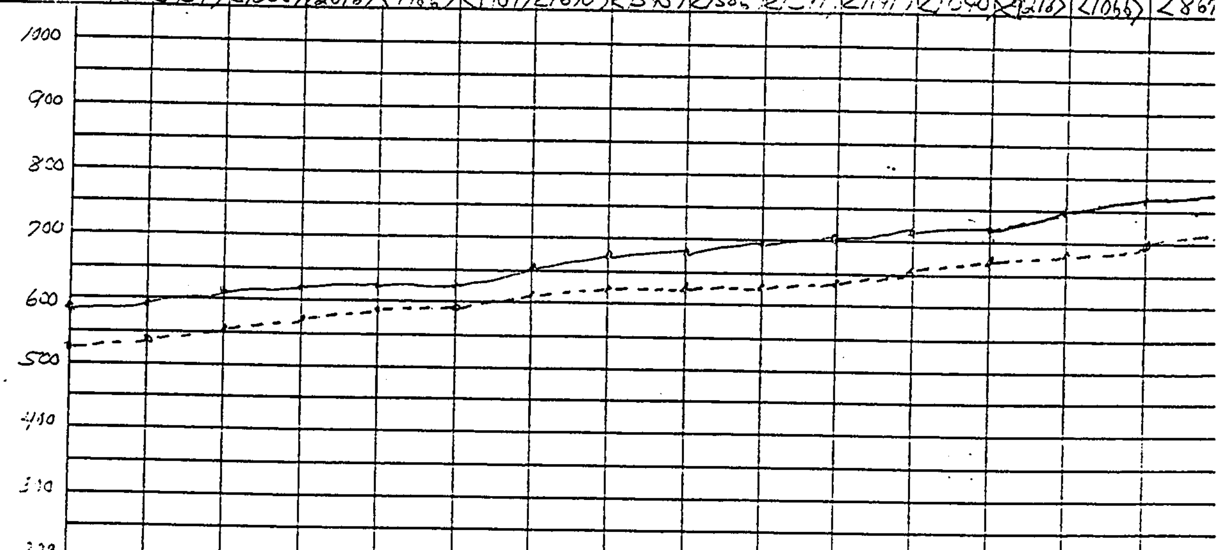
9. COST STATUS
a. $ Expressed in: Millions
b. Budget and Reporting No.: AC1510100
c. Cost Plan Date: 6-23-93
d. Actual Costs Prior Years: 19,722
e. Planned Costs Prior Years: 14,082
f. Total Estimated Cost for Contract: 10,885
g. Total Contract Value: 2.985
h. Estimated Subsequent Reporting Period



Accrued Costs	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	630	630	214	330	330	330	330	330	230	330	330	330	330	330	330
h. Actual	214	239	319	490	300	252	91	255	321	135.	80	229	508	178	131
i. Variance	416	391	<105>	<160>	30	77	239	75	09	195	250	101	<178>	152	199
j. Cumulative Variance	<2143>	<1751>	<1856>	<2016>	<1986>	<1909>	<1670>	<1595>	<1586>	<1391>	<1141>	<1040>	<1218>	<1066>	<867>

10. LABOR STATUS
a. Labor Expressed in: THOUSANDS
b. Labor Plan Date: N/A Direct Labor
c. Planned Labor Prior Fiscal Years: $530
d. Actual Labor Prior Fiscal Years: 582
e. Total Estimated Labor for Contract: 465
f. Total Contract Labor: N/A

LEGEND
Planned: - - - - - -
Actual: ______
Projected: . . . .



Labor	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
g. Planned	15	15	15	13	13	13	13	13	13	13	13	13	13	13	13
h. Actual	15	11	9	5	15	18	19	8	17	3	4	5	5	18	4
i. Variance	2	4	6	8	<2>	<5>	<6>	5	<4>	10	9	8	7	<5>	9
j. Cumulative Variance	<43>	<39>	<33>	<25>	<27>	<32>	<38>	<33>	<37>	<27>	<18>	<10>	<3>	<11>	<2>

11. MILESTONES — STATUS — COMMENTS

12. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] STATUS REPORT

DOE F1332.3
(11-84)

FORM APPROVED
OMB NO. 1901-1400

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	**Oct. 1, 1995 - Dec. 31, 1995**	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS		5. START DATE **June 1, 1993**
Texaco Exploration and Production Inc. **400 Poydras St.** **New Orleans, LA 70130**		6. COMPLETION DATE **December 31, 1997**

7. ELEMENT CODE	8. REPORTIN ELEMENT	9. DURATION 1993				1994				1995				CURRENT FISCAL YEAR 1996				FY 1997						10. PERCENT COMPLETE	
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q			a. Plan	b. Actual
1.1	Geologic & Engineering				1																			100%	100%
1.2	Extraction Technology				2																			100%	100%
2.1	Recording Daily Production				3																A			50%	50%
2.2	Reservoir Charac-terization				4	B					C													100%	100%
2.3	Site Operation & Field Work		D	E					F															100%	100%
2.4	CO2			6																				50%	50%
2.5	EH&S Monitoring & Compliance		G H	7																			I	50%	50%
3.1	CO2 Screening Model						J	8																100%	100%
3.2	Environmental Analysis									9														100%	100%
3.3	FDD Database & Model									K				10										80%	80%
3.4	Technical Publications								L								L		11				11	50%	50%

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

DOE F1332.3 ATTACHMENT
(11-84)

U.S. DEPARTMENT OF ENERGY
MILESTONE SCHEDULE [ ] PLAN [X] SCHEDULE
(ATTACHMENT)

1. TITLE	2. REPORTING PERIOD	3. IDENTIFICATION NUMBER
Post Waterflood CO2 Miscible Flood in a Light Oil Fluvial Dominated Deltaic Reservoir	Oct 1, 1995 - Dec. 31, 1995	**DE-FC22-93BC14960**
4. PARTICIPANT NAME AND ADDRESS **Texaco Exploration and Production Inc.** **400 Poydras St.** **New Orleans, LA 70130**		5. START DATE **June 1, 1993** 6. COMPLETION DATE **December 31, 1997**

MAJOR EVENTS	DATE	DESCRIPTION	STATUS
1	10/15/92	TASK 1.1 - GEOLOGICAL RESERVOIR DESCRIPTION AND LAB TESTS	COMPLETED
2	10/15/92	TASK 1.2 - PHASE 1 RESERVOIR SIMULATION	COMPLETED
3	08/01/93	TASK 2.1 - RECEIVE DOE APPROVAL TO INJECT CO2	COMPLETED
4	08/01/93	TASK 2.2 - RESERVOIR PRESSURE IS RAISED TO 2700 PSI BY WATER INJECTION	COMPLETED
5	08/15/93	TASK 2.3 - CO2 INJECTION AND PRODUCTION FACILITY IS COMPLETED	COMPLETED
6	08/15/93	TASK 2.4 - CO2 PIPELINE IS INSTALLED	COMPLETED
7	08/15/93	TASK 2.5 - NEPA CATEGORICAL EXCLUSION IS RECEIVED	COMPLETED
8	12/31/95	TASK 3.1 - SPE PAPER AND RELEASE OF CO2 SCREENING MODEL	COMPLETED
9	12/31/94	TASK 3.2 - TOPICAL REPORT ON ENVIRONMENTAL CONSTRAINTS	COMPLETED
10	12/31/95	TASK 3.3 - TOPICAL REPORT ON FDD DATABASE	PROJECT 80% COMPLETE
11	12/31/97	TASK 3.4 - SPE PAPER ON RESERVOIR CHARACTERIZATION	TO BE PRESENTED 1997

INTERMEDIATE EVENTS	DATE	DESCRIPTION	STATUS
A	12/31/97	TASK 2.1 - FINAL PROJECT REPORT	TO BE COMPLETED DURING 1997
B	12/31/93	TASK 2.2 - UPDATED RESERVOIR MODEL COMPLETED	COMPLETED
C	12/01/94	TASK 2.2 - CONVENTIONAL CORE ANALYZED IN POLK "B" #39 WELL	DEFERRED
D	04/30/93	TASK 2.3 - 10 WELL WORKOVER PROGRAM COMPLETED	COMPLETED
E	10/01/93	TASK 2.3 - HORIZONTAL CO2 INJECTION WELL DRILLED, POLK "B" #2 W/O PERFORMED	HORIZ. WELL COMPLETE, POLK "B" W/O CANCELLED
F	12/01/94	TASK 2.3 - VERTICAL CO2 INJECTION WELL DRILLED (POLK "B" #39)	CANCELLED
G	06/10/93	TASK 2.5 - PERMIT FOR CO2 PIPELINE RECEIVED FROM ARMY CORPS OF ENGINEERS	COMPLETED
H	06/30/93	TASK 2.5 - HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	COMPLETED
I	12/31/97	TASK 2.5 - FINAL HAZARDOUS SUBSTANCE PLAN SUBMITTED TO DOE	TO BE COMPLETED DURING 1997
J	12/31/94	TASK 3.1 - CO2 SCREENING MODEL FINAL REPORT SUBMITTED TO DOE	COMPLETED
K	12/31/94	TASK 3.3 - FDD DATABASE STUDY IS COMPLETED BY LSU	LSU WORK WILL BE COMPLETED IN SPRING, 1996
L	04/18/94	TASK 3.5-1ST SPE PAPER PRESENTED-PROJECT IMPLEMENTATION	COMPLETED

11. SIGNATURE OF PARTICIPANT'S PROJECT MANAGER AND DATE

Approved by Office of Management and Budget No 80-80182

FEDERAL CASH TRANSACTIONS REPORT

(See instructions on the back. If report is for more than one grant or assistance agreement, attach completed Standard Form 272-A.)

1. Federal sponsoring agency and organizational element to which this report is submitted	**U. S. Department of Energy**		
2. RECIPIENT ORGANIZATION		4. Federal grant or other identification number	5. Recipient's account number or identifying number
Name	**Texaco Exploration and Production Inc.**	**DE-FC22-93BC14960**	[redacted]
Number and Street	**400 Poydras St.**	6. Letter of credit number **NA**	7. Last payment voucher number **-**
		Give total number for this period	
City, State and Zip Code:	**New Orleans, Louisiana 70130**	8. Payment Vouchers credited to your account **-**	9. Treasury checks received (whether or not deposited) **0**
		10. PERIOD COVERED BY THIS REPORT	
3. FEDERAL EMPLOYER IDENTIFICATION NO>	**51-0265713**	FROM (month,day,year) **10/01/95**	TO (month,day,year) **12/31/95**

11. STATUS OF FEDERAL CASH	a. Cash on hand beginning of reporting period	$0.00
	b. Letter of credit withdrawals	$0.00
	c. Treasury check payments	$222,321.30
	d. Total receipts (Sum of lines b and c)	$222,321.30
	e. Total cash available (Sum of lines a and d)	$222,321.30
	f. Gross disbursements	$222,321.30
	g. Federal share of program income	$0.00
	h. Net disbursements (Line f minus line g)	$222,321.30
	i. Adjustments of prior periods	$0.00
	j. Cash on hand end of period	$0.00
12. THE AMOUNT ON LINE j. REPRESENTING	13. OTHER INFORMATION	
	k. Interest income	$0.00
	l. Advances to subgrantees or subcontractors	$0.00

14. REMARKS

15. CERTIFICATION

AUTHORIZED CERTIFYING OFFICIAL	SIGNATURE	DATE REPORT SUBMITTED **01/29/96**
	TYPED OR PRINTED NAME AND TITLE **Sami Bou-Mikael - Project Manager**	TELEPHONE (Area Code, Number, Extension) **(504) 593-4565**

THIS SPACE FOR PRIVATE USE

272-102

STANDARD FORM 272 (7-76)
Prescribed by Office of Management and Budget
Cir. No. A-110