DOE/BC/14960--16

ANNUAL REPORT - FISCAL YEAR 1996

"POST WATERFLOOD CO_2 MISCIBLE FLOOD IN LIGHT OIL, FLUVIAL-DOMINATED DELTAIC RESERVOIR"

DE-FC22-93BC14960

TEXACO EXPLORATION AND PRODUCTION INC.

AUGUST 15, 1996

AWARD DATE : June 1, 1993.
COMPLETION DATE: December 31,1997

Project Manager (Texaco) Sami Bou-Mikael
COR (DOE) Chandra Nautiyal
Contract Specialist (DOE) John N. Augustine

Reporting Period:June 1, 1995 - May 31, 1996

DISCLAIMER

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Executive Summary

The Port Neches CO_2 flood shown in Figure 1, is a joint operation between the Department of Energy (DOE) and the Texaco Exploration and Production Inc. (TEPI) that has been operating for nearly four years. The project performance during the past year has been adversely affceted by several factors including: Water blockage, low residual oil saturation and wellbore mechanical problems.

TEPI attempted to test a new procedure in an new fault block using CO_2 to accelerate primary production in order to improve the primary reserves net present value. the test was abandoned when the discovery well Polk B#39 for the Marg Area 3 was a dry hole. Also, during this pariod TEPI terminated all new CO_2 purchases from Cardox for economical reasons, while continuing to recycle produced CO_2.

A data base for FDD reservoirs for the Louisiana and Texas Gulf Coast Region was developped by LSU and SAIC. This data base includes reservoir parameters and performance data for reservoirs with significant production and OOIP volumes that are amenable to CO_2 injection. A paper discussing the Port Neches CO_2 project was presented at the 1996 SPE/DOE Symposium on Improved Oil Recovery.

DISCUSSION OF RESULTS - FIELD OPERATIONS.

When miscible CO_2 operations began in 1993, it was estimated that the project will recover 2.2 MMSTB of incermental oil, or 195 of the OOIP. These estimates were based on a reservoir model and other classical reservoir engineering calculations. The flood produced so far 300 MSTB of tertiary oil to date. The production peacked at 500 BOPD in october of 1994 as indicated in Figure 2. this was below the anticipated 800 BOPD rate predicted by the model. It is estimated that the incremental reserves will be reduced by as much as 1.5 MMSTB. The reservoir under-performance is due to several factors: Reservoir characterization, oil saturation, water blockage and mechanical problems. These issues are discussed in more details in the paper presented at the 1996 SPE/DOE Symposium in Tulsa.

Production from the Marg Area 1 has continuously declined from 325 BOPD in June of 1995 to 100 BOPD in May of 1996. This sharp decline is due mainly to lower sweep efficiency caused by water blockage that prevented the CO_2 from contacting oil away from the line between the injection and production wells. This problem was augmented by mechanical failure of gravel-pack screens in two main producers.

Based on the reservoir performance and the amount of remaining recoverable tertiary reserves, TEPI obtained DOE approval to terminate CO_2 purchases from Cardox, while continuing to operate the project with recycled CO_2. Prior to terminating CO_2 operations, TEPI attempted to test a new procedure to accelerate primary production rates using CO_2 injection in an untested fault block. Under miscible conditions, CO_2 disolves in the reservoir oil displacing its methane, making it highly mobile. Since CO_2 is a highly compressible fluid that disolves in the reservoir oil at a rate of 4 to 1 when compared to natural gas. This makes the oil highly mobile and capable to flow at a higher rate and pressure. Introducing the CO_2 at the oil-water contact will eliminate the need for any artificial lift of the oil and form a buffer zone between the oil and the water, that reduces the water production. This test was abandoned when the well drilled to the Marg Area 3 was a dry hole.

A new fully compositional reservoir model was developped by EPTD to simulate the reservoir performance including the CO_2 injection phase. The results from this model were used to make decision on reducing the project tertiary reserves and terminate CO_2 purchases earlier than originally planned. Based on the simulation results, a workover was performed on well Kuhn #42 to convert it to CO_2 injector in order to improve the reservoir sweep efficiency. The response from CO_2 injection in Kuhn #42 has not yet been seen in the adjacent wells.

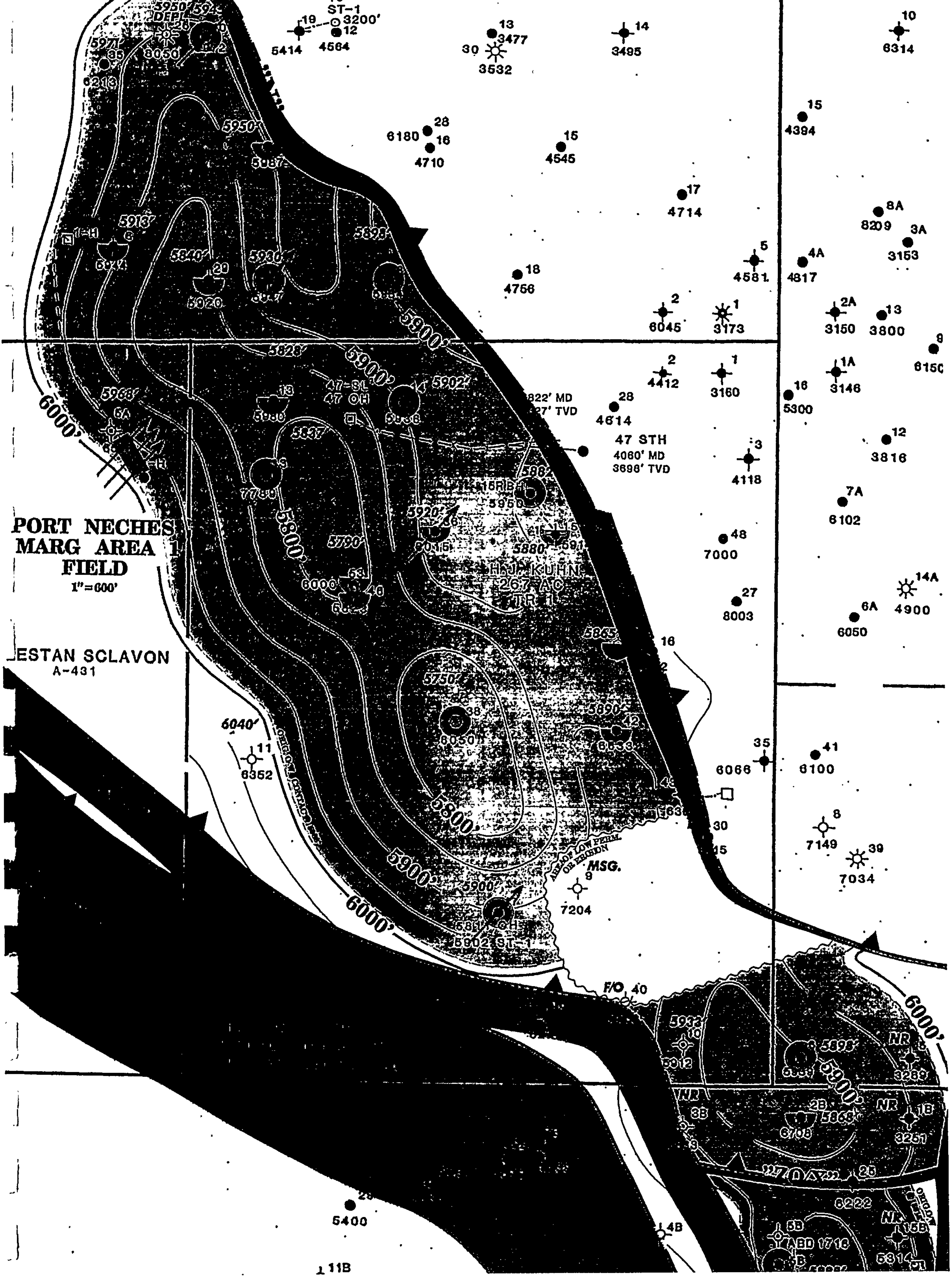
The following is a list of the most recent well tests taken during the month of June 1996 for the producing wells:

producers:	Kuhn #15R	82 BOPD,	274 BWPD,	840 PSI,	22 CHOKE.
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.		

The Notice of Energy RD&D Project, Cost Plan, Milestone plan, Financial Status Report, Summary Report, Federal Transaction report are included in Appendix A.

DISCUSSION OF RESULTS - TECHNOLOGY TRANSFER.

Texaco presented an SPE paper at the SPE/DOE Tenth Annual Symposium on Improved Oil recovery held in Tulsa last April. A copy of the SPE/DOE # 35362 is shown in Appendix B. As technology transfer partners LSU and SAIC also published two reports ranking reservoirs in Texas and Louisiana Gulf Coast that are amenable to CO_2 injection. LSU presented an SPE paper on the subject at the 1996 SPE/DOE Symposium.



PORT NECHES
MARG AREA 1
FIELD
1"=600'
ESTAN SCLAVON
A-431
H.J. KUHN
267 AC
TR 1
47 STH
4060' MD
3698' TVD
47-SL
47 OH
ST-1
3200'
MSG.
F/O 40
AREA OF LOW PERM. OR EROSION
6000'
5900'
5800'
5950'
5913'
5840'
5930'
5898'
6020
5828'
5968'
5902'
5837'
7780
5920'
5790'
5880'
5865'
5750'
6050
5890'
6040'
6352
6000'
5902 ST-1
5898'
5868'
6222
ABD 1716
3289
3251
5400
4564
5414
3477
3532
3495
6314
6180
4710
4545
4394
4714
8209
3153
4756
4581
4817
6045
3173
3150
3800
6150
4412
3160
5300
3146
4614
3816
4118
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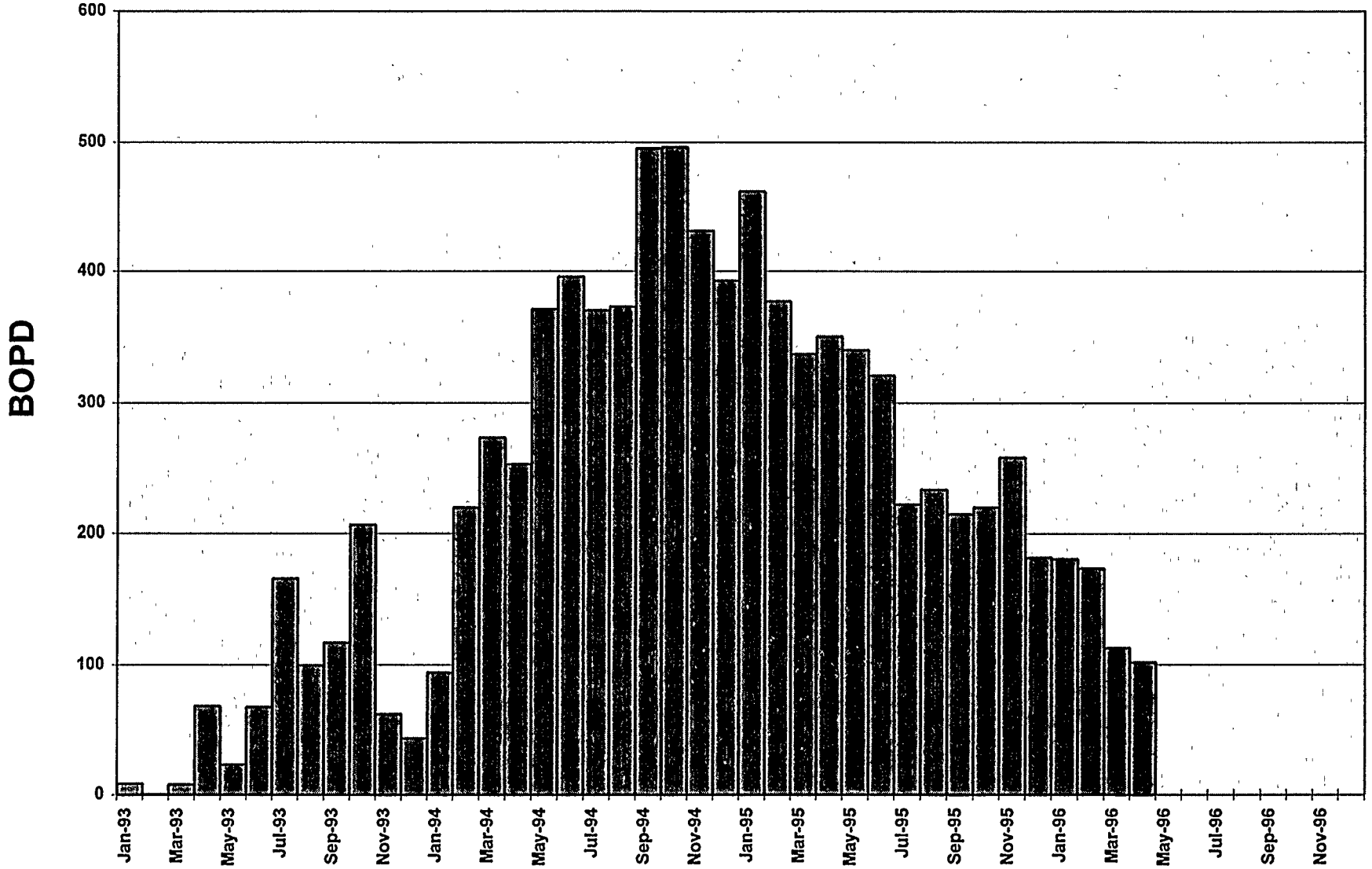
4900
8003
6050
6066
6100
7149
7034
7204

PORT NECHES CO2 PROJECT

ALLOCATED PRODUCTION



APPENDIX "A"

DOE F 1430.22
(04-91)
All other editions
are obsolete
(Replaces DOE F 538)

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 DE

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, or 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 Bou-Mikael First Sami MI

B. Phone: Commercial (504) 593-4565 FTS

4. DOE SPONSORING OFFICE OR DIVISION Bartlesville Office

5. TITLE OF PROJECT Post Waterflood CO2 Miscible Flood In Light Oil Fluvial Dominated Deltaic Reservoir

6. DESCRIPTIVE SUMMARY (limit to 200 words)

Please see attached

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 Bou-Mikael First Sami MI

Address 400 Poydras

City New Orleans State LA Zip 70130

Phone (504) 593-4565 Date August 15, 1996

Notice of Energy RD & D Project.

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 this report.

Milestone Plan
Budget Period 2

Updated milestone plan submitted with the project continuation application in October 1994:

1- Update the reservoir simulation model	Completed	3/01/96
2- Drill and complete Polk B+39 in area 2	Canceled	
3- Workover Polk B#5	Completed	
4- Begin CO_2 injection in area 2	Canceled	
5- Submit screening FDD topical report	Completed	4/30/96
6- Present SPE paper on screening	Completed	4/21/96
7- Complete reservoir characterization topical report	----------	12/31/97
8- Submit SPE Paper on reservoir characterization	----------	12/31/97
9- Submit final project topical report	----------	12/31/97
10- DOE cost sharing ends	----------	12/31/97