

**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, or 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.

**TITLE: IMPROVED OIL RECOVERY IN MISSISSIPPIAN CARBONATE RESERVOIRS OF KANSAS -- NEAR TERM -- CLASS 2**

Cooperative Agreement No.: DE-FC22-94BC14987

Contractor Name and Address: The University of Kansas Center for Research Inc.

Date of Report: June 1, 1999

Award Date: September 16, 1994

DOE Cost of Project: \$ 3,169,252 (Budget Period 2 05/16/97 -- 07/30/99)

Principal Investigators: Timothy R. Carr (Program Manager)  
Don W. Green  
G. Paul Willhite

Project Manager: Daniel J. Ferguson, NPTO Tulsa, Oklahoma

Reporting Period: October 1, 1998 -- December 31,1998

**OBJECTIVES**

The objective of this project is to demonstrate incremental reserves from Osagian and Meramecian (Mississippian) dolomite reservoirs in western Kansas through application of reservoir characterization to identify areas of unrecovered mobile oil. The project addresses producibility problems in two fields: Specific reservoirs target the Schaben Field in Ness County, Kansas, and the Bindley Field in Hodgeman County, Kansas. The producibility problems to be addressed include inadequate reservoir characterization, drilling and completion design problems, non-optimum recovery efficiency. The results of this project will be disseminated through various technology transfer activities.

At the Schaben demonstration site, the Kansas team will conduct a field project to demonstrate better approaches to identify bypassed oil within and between reservoir units. The approach will include:

- Advanced integrated reservoir description and characterization, including integration of existing data, and drilling, logging, coring and testing three new wells through the reservoir intervals. Advanced reservoir techniques will include high-resolution core description, petrophysical analysis of pore system attributes, and geostatistical analysis and 3D visualization of interwell heterogeneity.
- Computer applications will be used to manage, map, and describe the reservoir. Computer simulations will be used to design better recovery processes, and identify potential incremental reserves.

- Comparison of the reservoir geology and field performance of the Schaben Field with the previously described by slightly younger Bindley Field in adjacent Hodgeman, County.
- Drilling of new wells between older wells (infill drilling) to contact missed zones;
- Demonstration of improved reservoir management techniques, and of incremental recovery through potential deepening and recompletion of existing wells and targeted infill drilling.

## **SUMMARY OF TECHNICAL PROGRESS BUDGET PERIOD 2**

Progress is reported for the period from 1 October 1998 to 31 December 1998. Work in this quarter concentrated on monitoring the incremental recovery of additional mobile oil through targeted infill drilling (Task 2.1). An improved version of the full-field reservoir simulation is being completed with the addition of new infill wells, revised fluid data, and the addition of a second reservoir layer. Currently 22 infill wells have been drilled in Schaben Field subsequent to completion of the reservoir characterization and simulation (Table 1). These additional wells have successfully targeted incremental oil using the results of the Budget Period 1 study and the reservoir management plan. At the Schaben Demonstration Site, the additional infill locations and recompletions have resulted in an incremental production increase of 200 BOPD (Figure 1).

### **Task 2.1 DEMONSTRATION OF RESERVOIR MANAGEMENT STRATEGY**

From late 1996 through 1998, a total of twenty-two infill locations were drilled or recompleted at the Schaben Demonstration Site. The locations were selected based on the results of the reservoir management strategy developed in Budget Period 1 (See previous quarterly for a list). All three major field operators (Ritchie Exploration, Pickrell Drilling and American Warrior) used the Schaben reservoir simulation to evaluate multiple locations and select optimum locations. The history of each well is being evaluated and incorporated into a final revised full-field simulation. The current reservoir simulation has provided excellent full-field and good individual history matches for all existing wells. The simulation also provides an estimate of additional incremental oil as a result of targeted infill drilling.

The revised simulation uses a more realistic two-layer model of the Schaben reservoir. The reservoir characterization recognized two major stratigraphic units with different petrophysical properties (i.e., layers M1 and M0). The previous full-field model treated the two units as a single reservoir layer. In addition, new information on fluid rates and fluid levels have been incorporated into the model. The result is an improved model that requires significantly reduced local adjustments

### **Task 2.2 TECHNOLOGY TRANSFER**

Technology transfer is an ongoing process that includes access to information through the Internet, almost daily inquires and formal presentations. Four hours of hands-on demonstrations and presentations focusing on PFEFFER were presented at the North Midcontinent PTTC workshop in Wichita, Kansas (November 19). The short course involved well log analysis techniques with emphasis on modern logging technologies applicable to Kansas. These petrophysical techniques were a direct product of the Class 2 project. A manuscript covering the approach to geologic/engineering developed as part of the Class 2 project was completed (Watney and others, in press)

We continue to work with a number of Kansas's operators on application of the technologies developed as part of the Class 2 project. We are providing access to the digital data and results from the project through an on-line (Internet) accessible format (see Schaben homepage at <http://www.kgs.ukans.edu/Class2/index.html>).

## **REFERENCES**

1998, Watney, W. L. and Bohling, G., PFEFFER Demo, in Mark, Sandra, compiler, PTTC's Petroleum E&P Software Sampler, CD-ROM v. 1.0, PTTC, Washington.

In press, Watney, W.L., W.J. Guy, J.H. Doveton, S. Bhattacharya, P. M. Gerlach, G. C. Bohling, T. R. Carr, Petrofacies Analysis - A petrophysical tool for geologic/engineering reservoir characterization: Proceedings of the Fourth International Reservoir Characterization Technical Conference, Studies in Geology, American Association of Petroleum Geologists.

**Schaben Demonstration Area  
Average Daily Production  
KU Energy Research Center**  
Production Rate vs Time  
For the Period 01/1994 to 12/1998 | API:

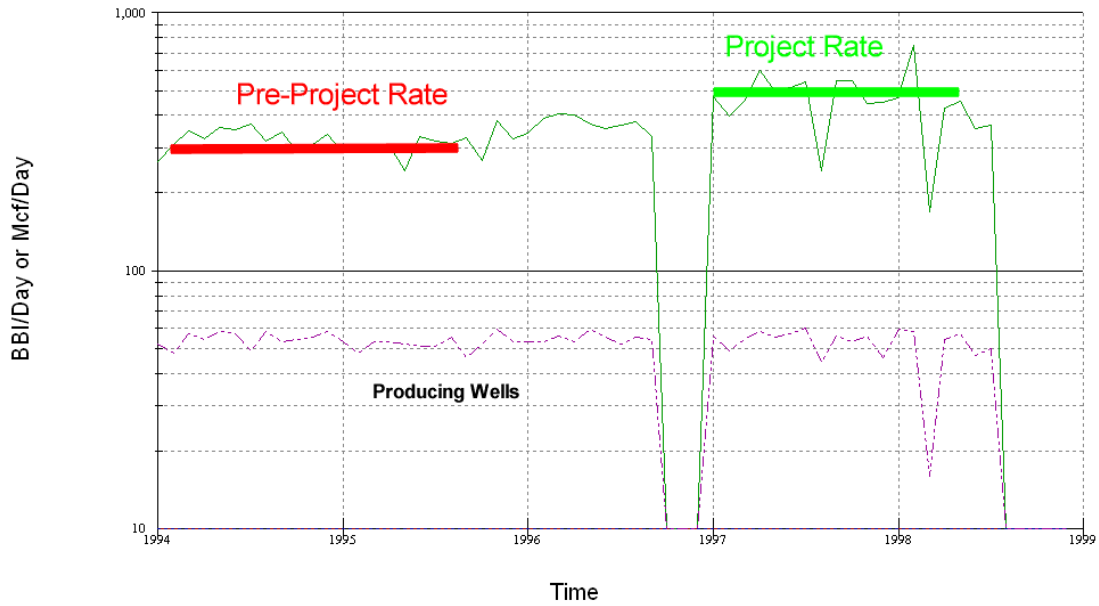


Figure 1.-- Plot of average daily production and producing wells from the Schaben Demonstration Area showing producing rates prior and after initiation of demonstration project. Increase in production is from approximately the same number of producing wells. Additional current production data for the Schaben Field and individual leases are available at <http://www.kgs.ukans.edu/DPA/Schaben/schabenMain.html> .

Well Name/Year	Operator	API Number	Status Rates Per Day	Location
4 BP Twin / 1996	Ritchie Exploration	15-135-23864	15 BO, 283 BW	30-19S-21W, NW-NW-NE
2 P Lyle Schaben / 1996	Ritchie Exploration	15-135-23925	53 BO, 97 BW	31-19S-21W, NE-NE-NE
1 Gneich P Twin / 1996	Ritchie Exploration	15-135-23933	13 BO 72 BW	19-19S-21W, SW-SW-SE
2-30 Moore / 1997	American Warrior	15-135-23800	37 BO 0 BW	30-19S-21W, SE-NE-SE
6 DP Moore / 1997	Ritchie Exploration	15-135-24006	60 BOPD, 100 BW, 241' FOP	30-19S-21W, NE-NW-NW
3 AP Humburg / 1997	Ritchie Exploration	15-135-24013	70 BOPD, 130 BW, 33' FOP	25-19S-22W, NW-SE-SE
4 Humburg / 1997	Pickrell Drilling	15-135-24010	70 BOPD, 130 BW, 1347' FOP	25-19S-22W, NE-NW-SE
3 Borger / 1997	Pickrell Drilling	15-135-23998	66 BOPD, 66 BW, 1426' FOP	25-19S-22W, SW-NE-NE
4 Wittman/ 1997	American Warrior	15-135-23958	108 BO. ? BW	19-19S-21W, SE-SW-SW
5 Wittman / 1997	American Warrior	15-135-23966	108 BO. ? BW	19-19S-21W, SW-SW-SW
7 Rein AP / 1997	Ritchie Exploration	15-135-24031	70 BOPD, 80 BW, 530' FOP	29-19S-21W, SW-NW-SW
5 DP Moore / 1997	Ritchie Exploration	15-135-23973	?	30-19S-21W, NE-NE-NW
4 CP Moore / 1997	Ritchie Exploration	15-135-24030	?	30-19S-21W, NW-NE-SW
4 Borger / 1997	American Warrior	15-135-24007	20 BO, 30 BW	25-19S-22W, SE-NW-NE
3-30 Moore / 1997	American Warrior	15-135-23801	25 BO, Little Water	30-19S-21W, NW-SE-NE
1-30 Moore / 1997	American Warrior	15-135-23799	13 BO, 21 BW	30-19S-21W, NW-SW-SW
3 Borger / 1997	American Warrior	15-135-23969	250' FOP	25-19S-22W, SE-SW-NE
2X Humburg	Mid Cont R	15-135-24015	12 BO, 60 BW	25-19S-22W, NW-NE-SE
4 Borger	Pickrell Drilling	15-135-24048	40 BO, 9 BW	25-19S-22W, NE-SE-NE
1-26 Gillig	American Warrior	15-135-24052	15 BO, 110 BW	26-19S-22W, NE-NE-SE
6 Williams	American Warrior	15-135-24053	15 BO, 150 BW	36-19S-22W, NE-NE-NW
6 Wittman	American Warrior	15-135-23958	20 BO, 30 BW	19-19S-22W, SE-SW-SW

**Table 1.** List of infill locations drilled or recompleted in the Schaben demonstration area from late 1996 through 1998. The majority of locations were selected based on the reservoir description and simulation results from the Schaben Study.

