

**QUARTERLY TECHNICAL PROGRESS REPORT  
FOR THE PERIOD ENDING MARCH 31, 2000**

**TITLE: FIELD DEMONSTRATION OF CARBON DIOXIDE MISCIBLE FLOODING  
IN THE LANSING-KANSAS CITY FORMATION, CENTRAL KANSAS**

**DOE Contract No. DE-AC26-00BC15124**

**Contractor:** University of Kansas Center for Research, Inc.  
2385 Irving Hill Road  
Lawrence, KS 66044

**DOE Program:** Class II Revisited - Field Demonstrations

**Award Date:** March 8, 2000

**Total Project Budget:** \$5,388,683

**DOE Cost Amount:** \$1,892,094

**Program Period:** March 8, 2000 – March 8, 2006 (BP1 03/00-03/01, BP2 03/01-03/05, BP3 03/05-03/06)

**Reporting Period:** March 8, 2000 – March 31, 2000

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

**Contractor Contact:** Alan P. Byrnes  
Kansas Geological Survey  
1930 Constant Ave., Lawrence, Kansas 66047  
email: [abyrnes@kgs.ukans.edu](mailto:abyrnes@kgs.ukans.edu)  
phone: 785-864-2177

**Principal Investigators:** Alan Byrnes (Program Manager Budget Period 1)  
G. Paul Willhite (Program Manager Budget Periods 2&3)  
Don Green, Martin Dubois, Richard Pancake, Timothy Carr, W.  
Lynn Watney, John Doveton, Willard Guy, Rodney Reynolds,  
Rajesh Kunjithaya, Dave Murfin, James Daniels, Larry Jack, Niall  
Avison, Lanny Schoeling, Russell Martin

**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 herein do not necessarily state or reflect those of the United States Government or any agency thereof.**

**ABSTRACT:**

Currently work is being performed on Tasks 1.1, 1.2, 1.3, and 7.0. Well data are being collected, inventoried and scanned for web access. Core, log, and engineering analysis is being performed to better understand the reservoir system. Remediation of Colliver #18 has been scheduled to allow injection testing and obtain pilot area permeability-height data. Collection of reservoir pressure data has been scheduled. The project has not reached any scheduled milestones to date. Progress is reported for the period from February 8, 2000 to March 30, 2000. Work in this quarter concentrated on compilation of well data and reservoir characterization. This quarterly report will concentrate on a brief summary of work performed under Tasks 1.1, 1.2, 1.3, and 7.0.

## TABLE OF CONTENTS

Title Page .....	1
Disclaimer .....	2
Abstract .....	2
Table of Contents .....	3
List of Tables .....	3
List of Figures .....	3
Introduction .....	4
Executive Summary .....	5
Results and Discussion .....	5
Task 1.1 Acquisition of Data and Materials .....	5
Task 1.2 Reservoir Characterization .....	5
Task 1.3 Reservoir Model .....	5
Task 7.0 Project Management .....	6
Conclusions .....	6

## LIST OF TABLES

None

## LIST OF FIGURES

None

## **INTRODUCTION**

**Objectives** - The objective of this Class II Revisited project is to demonstrate the viability of carbon dioxide miscible flooding in the Lansing-Kansas City formation on the Central Kansas Uplift and to obtain data concerning reservoir properties, flood performance, and operating costs and methods to aid operators in future floods. The project addresses the producibility problem that these Class II shallow-shelf carbonate reservoirs have been depleted by effective waterflooding leaving significant trapped oil reserves. The objective is to be addressed by performing a CO<sub>2</sub> miscible flood in a 40-acre pilot in a representative oomoldic limestone reservoir in the Hall-Gurney Field, Russell County, Kansas. At the demonstration site, the Kansas team will characterize the reservoir geologic and engineering properties, model the flood using reservoir simulation, design and construct facilities and remediate existing wells, implement the planned flood, and monitor the flood process. The results of this project will be disseminated through various technology transfer activities.

### **Project Task Overview -**

**Activities in Budget Period 1 (03/00-03/01)** involve reservoir characterization, modeling, and assessment:

- Task 1.1- Acquisition and consolidation of data into a web-based accessible database
- Task 1.2 - Geologic, petrophysical, and engineering reservoir characterization at the proposed demonstration site to understand the reservoir system
- Task 1.3 - Develop descriptive and numerical models of the reservoir
- Task 1.4 - Multiphase numerical flow simulation of oil recovery and prediction of the optimum location for a new injector well based on the numerical reservoir model
- Task 2.1 - Drilling, sponge coring, logging and testing a new CO<sub>2</sub> injection well to obtain better reservoir data
- Task 2.2 - Measurement of residual oil and advanced rock properties for improved reservoir characterization and to address decisions concerning the resource base
- Task 3.1 - Advanced flow simulation based on the data provided by the improved characterization
- Task 3.2 - Assessment of the condition of existing wellbores, and evaluation of the economics of carbon dioxide flooding based on the improved reservoir characterization, advanced flow simulation, and engineering analyses
- Task 4.1 – Review of Budget Period 1 activities and assessment of flood implementation

**Activities in Budget Period 2 (03/01-03/05)** involve implementation and monitoring of the flood:

- Task 5.1 - Remediate all wells in the flood pattern
- Task 5.2 - Re-pressure the pilot area by water injection
- Task 5.3 - Construct surface facilities
- Task 5.4 - Implement CO<sub>2</sub> flood operations
- Task 5.5 - Analyze CO<sub>2</sub> flooding progress - carbon dioxide injection will be terminated at the end of Budget Period 2 and the project will be converted to continuous water injection.

**Activities in Budget Period 3 (03/05-03/06)** will involve post-CO<sub>2</sub> flood monitoring:

- Task 6.1 – Collection and analysis of post-CO<sub>2</sub> production and injection data

**Activities that occur over all budget periods include:**

- Task 7.0 – Management of geologic, engineering, and operations activities
- Task 8.0 – Technology transfer and fulfillment of reporting requirements

## **EXECUTIVE SUMMARY:**

Currently work is being performed on Tasks 1.1, 1.2, 1.3, and 7.0. Well data are being collected, inventoried and scanned for web access. Core, log, and engineering analysis is being performed to better understand the reservoir system. Remediation of Colliver #18 has been scheduled to allow injection testing and obtain pilot area permeability-height data. Collection of reservoir pressure data has been scheduled. The project has not reached any scheduled milestones to date.

Progress is reported for the period from February 8, 2000 to March 30, 2000. Work in this quarter concentrated on compilation of well data and reservoir characterization. This quarterly report will concentrate on a brief summary of work performed under Tasks 1.1, 1.2, 1.3, and 7.0.

## **RESULTS AND DISCUSSION:**

### **Task 1.1 ACQUISITION OF DATA AND MATERIAL**

Well file data have been obtained from Murfin Drilling files. These have been partially inventoried and selection made of initial images to be scanned and entered on the web.

A web site has been constructed for the demonstration project and for data file exchange between project participants: <http://www.kgs.ukans.edu/ERC/CO2Pilot/index.html> .

### **TASK 1.2 RESERVOIR CHARACTERIZATION**

Special core analysis on oomoldic limestones from the Central Kansas Uplift has begun. Porosity, permeability and grain densities were measured on approximately 160 core plugs. Mercury capillary pressure was measured on eight samples. Air-brine capillary pressure is in progress.

An initial fifteen rock samples have had thin sections prepared and analyzed. These exhibit a range of pore types including isolated oomolds, connected oomolds, vuggy, microcrystalline, fractured, interparticle, and macroporous cement. An additional 50 samples will be selected for additional thin section preparation.

Wireline logs for 41 wells in the area of the pilot have been obtained, digitized and analyzed. The majority of these logs are older gamma ray – neutron logs with no resistivity logs but these appear to provide adequate porosity evaluation within  $\pm 2$  porosity percent. The remaining logs in the area are being obtained.

### **TASK 1.3 RESERVOIR MODEL**

Injection data from well files was collected and analyzed to estimate reservoir permeability. Calculated permeability for the Colliver #18 is 46 md and for the Carter #10 is 17 md. Additional injection data are being collected.

## **TASK 7.0 PROJECT MANAGEMENT**

A first meeting of all project participants was held in Wichita on February 29, 2000. Contract status was reviewed as well as tasks and milestones for the first year. Plans for remediation of the Colliver #18 injection well were discussed. Analysis of existing data for this well indicates that it is suitable for converting to a second injector and will have all zones squeezed off and be re-perforated in the Lansing-Kansas City and injection tested. This workover is being scheduled.

MV Energy, LLC has put together the paperwork necessary for unitizing the Colliver and Carter leases so that surface facility design and the new injector well placement can be optimal. Paperwork is being sent out to all owners in early April.

### **CONCLUSIONS:**

Collection of data for reservoir characterization and compilation and analysis of the data are proceeding. Analysis of oomoldic limestones of central Kansas is providing a framework for construction of the reservoir geomodel.