DOE/BC/14937--1

TITLE: REACTIVATION OF AN IDLE LEASE TO INCREASE HEAVY OIL RECOVERY THROUGH APPLICATION OF CONVENTIONAL STEAM DRIVE TECHNOLOGY IN A LOW DIP SLOPE AND BASIN RESERVOIR IN THE MIDWAY-SUNSET FIELD, SAN JOAQUIN BASIN, CALIFORNIA

Cooperative Agreement No.: DE-FC22-95BC14937

Contractor Name and Address: Earth Sciences & Resources Institute, University of Utah, Salt Lake City, UT 84112

Date of Report: December 19, 1995

Award Date: June 14, 1995

Anticipated Completion Date: March 13, 2000

Government Award for Current Budget Period: \$ 637,891.00

Principal Investigator: Steven Schamel

Project Manager: Edith C. Allison, Bartlesville Project Office

Reporting Period: June 14, 1995-September 30, 1995

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Objective

This project will reactivate ARCO's idle Pru Fee lease in the Midway-Sunset field, California and conduct a continuous steamflood enhanced oil recovery demonstration aided by an integration of modern reservoir characterization and simulation methods. Cyclic steaming will be used to reestablish baseline production within the reservoir characterization phase of the project. During the demonstration phase, a continuous steamflood enhanced oil recover will be initiated to test the incremental value of this method as an alternative to cyclic steaming. Other economically marginal Class III reservoirs having similar producibility problems will benefit from insight gained in this project. The objectives of the project are: (1) to return the shut-in portion of the reservoir to commercial production; (2) to accurately describe the reservoir and recovery process; and (3) to convey the details of this activity to the domestic petroleum industry, especially to other producers in California, through an aggressive technology transfer program.

The 40 ac Pru Fee property is located in the super-giant Midway-Sunset field and produces from the late Miocene Monarch Sand, part of the Monterey Formation. The Midway-Sunset Field was drilled prior to 1890. In 1991 cumulative production reached two billion barrels, with remaining reserves estimated to exceed 695 MMBO. In the Pru Fee property, now held by ARCO Western Energy, cyclic steaming was used to produce

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13° API oil. However, the previous operator was unable to develop profitably this marginal portion of the Midway-Sunset field using standard enhanced oil recovery technologies and chose rather to leave nearly 3.0 MMBO of oil in the ground that otherwise might have been produced from the 40 ac property. Only 927 MBO had been produced from the property when it was shut-in in 1987. This is less than 15% of the original oil-in-place, which is insignificant compared to typical heavy oil recoveries in the Midway-Sunset field of 40 to 70%. Target additional recoverable oil reserves from the 40 ac property are 2.9 MMBO. The objective of the demonstration project is to encourage a similar incremental increase in production in all other marginal properties in the Midway-Sunset and adjacent fields in the southern San Joaquin Basin.

The producibility problems thought to be responsible for the low recovery in the Pru Fee property are: (a) the shallow dip of the bedding, (b) complex reservoir structure, (c) thinning pay zone, and (d) the presence of bottom water. The project will use tight integration of reservoir characterization and simulation modeling to overcome these problems. If the demonstration project is successful, this methodology may be applied to other economically marginal reservoirs that have similar producibility problems.

Summary of Technical Progress

The project was initiated during this reporting period. Nevertheless, the work has progressed on schedule along a number of parallel tracks.

Literature compilation

A project bibliography was assembled during the first weeks of the project to assist the project team with reviewing the existing literature dealing with slope and basin clastic (Class III) reservoirs, the regional geology of the southern San Joaquin Basin, and the petroleum geology of the Midway-Sunset Field and similar oil fields in southern California. The bibliography was developed from GeoRef™ and the personal libraries of the project team members. It is organized using EndNote® and will be released as part of the overall project database in both an EndNote® and a “rich text” format.

Assembly of digitized log suites

A project area is defined as the Pru Fee property and a corridor 500 ft in width surrounding the property. Within the project area 135 wells have been identified for which some type of log data is available. Ninety of the wells have digital logs. The location of the wells have been verified and the quality of the logs checked by Mike Simmons of ARCO Western Energy (AWE). Those logs that had not already been loaded into a TerraStation™ database were added to the project file. Logs not currently in the AWE database have been requested. These additional log suites will be digitized and

added to the project database. The existing electronic database was transferred to the other team members responsible for carrying out the stratigraphic analysis.

Development of a stratigraphic framework

In advance of developing a reservoir model for the Pru Fee demonstration site, the stratigraphy of the project site is being characterized in considerable detail. The goal is to (a) develop a three dimensional representation of the major sand bodies and intervening barriers, (b) delineate the sedimentary facies and depositional setting, and (c) tie lithologic and petrophysical properties of the rocks to the geometric and depositional framework. Key to developing the stratigraphic model is correlation of log responses in the wells within the project area to the new production well drilled, cored and logged during the latter half of September. The project well log files (TerraStation™ database) that were transferred to Dr. Douglas Sprinkel in Salt Lake City have been examined and initial correlations made. However, the stratigraphic analysis will begin in earnest only after the new producer well logs and core analyses are available in late October.

Install lease production facilities

In preparation for the cyclic injection and production baseline tests at the demonstration site, the site has been resurveyed, the PLC panel has been upgraded with new dynamic surveillance software, many of the flowlines have been replaced, the production header has been repaired and modified, and a nearby idle fresh water knock-out (FWKO) has been converted to the Pru wet lact. Work has begun to convert the old Pru wet lact to a well tester. Under the supervision of Robert Swain (AWE), this task is nearly complete.

Return wells to production

Idle wells already on the Pru demonstration site have been inspected, repaired and equipped as injection/production wells for the baseline tests. This task is complete.

Drill producer and observation wells

A new production well and an observation well near the center of the demonstration site were planned, permitted and drilled. The wells were completed and equipped in late September. The producer, Well No.101, will be steamed for the baseline tests. The adjacent observation well is equipped for temperature monitoring during the steaming. A core was removed from the producer well with over 80% recovery. Missing intervals were subsequently sampled with sidewall cores. This task is now complete.

Reservoir characterization

Initial "trial" reservoir simulations have been started by Dr. Milind Deo and his graduate student Hong Mei Huang to examine model sensitivities for the Pru Fee demonstration site. Using reasonable reservoir properties for the Upper Monarch sand in the Midway-Sunset field provided by Robert Swain of AWE preliminary simulations were performed to assess the effect of bottom water on cyclic and steam flood processes. The geometric parameters match closely what is known about the demonstration site in the Pru Fee property and conventional AWE production methods. The initial models found that in both the cyclic steam and the steam flood processes, the presence of bottom water decreased production, but not significantly. This was due to heat losses to the water zone. In general, the bottom water has lesser impact on the steam flood process than on the cyclic process. The reservoir simulations are continuing as more site specific data are made available from other team members in the course of the ongoing stratigraphic and reservoir modeling studies.

The optimal software strategies for three dimensional (3-D) representation of the reservoir are being investigated by Dr. Craig Forster in advance of completion of the stratigraphic modeling.

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(See instructions on reverse side. Use plain bond paper if additional space is needed for explanations.)

PART I (DOE, DOE Contractors, Grantees, and Awardees complete)

A. Product/Report Data

1. (Award) Contract No. DE-FC22-95BC14937

2. Title Reactivation of an Idle Lease to Increase Heavy Oil Recovery Through Application of Conventional Steam Drive Technology in a Low Dip Slope & Basin Reservoir in the

3. Product/Report Description Midway-Sunset Field, San

☒ a. Report (Complete all that apply) Joaquin Basin, California

(1) ☐ Print ☒ Nonprint (specify) _____

(2) ☒ Quarterly ☐ Semiannual ☐ Annual ☐ Final

☐ Topical ☐ Phase I ☐ Phase II

☐ Other (specify) _____

Dates covered 7/95 thru 9/95

☐ b. Conference/Meeting/Presentation (Complete all that apply)

(1) ☐ Print ☐ Nonprint (specify) _____

☐ Published proceedings

☐ Other (specify) _____

(2) Conference Title (no abbreviations) _____

Location (city/state/country) _____

Date(s) (m/d/y) / / thru (m/d/y) / /

Sponsor _____

☐ c. Software—Additional forms are required. Follow instructions on the back of this form.

☐ d. Other (Provide complete description) _____

B. Patent Information

Yes No

☐ ☒ Is any new equipment, process, or material disclosed?
If yes, identify page numbers _____

☐ ☒ Has an invention disclosure been submitted?

If yes, identify the disclosure number and to whom it was submitted. Disclosure number _____
Submitted to _____

☐ ☒ Are there patent-related objections to the release of this STI product? If so, state the objections. _____

C. Contact (Person knowledgeable of content)

Name Edith Allison

Phone 918/337-4390

Position Project Manager

Organization Bartlesville Project Office

PART II (DOE/DOE Contractors complete/or as instructed by DOE contracting officer)

A. DOE Identifiers

1. Product/Report Nos. DOE/BC/14937-1

2. Funding Office(s) (NOTE: Essential data) _____

B. Copies for Transmittal to AD-21 (OSTI)

(STI must be of sufficient quality for microfilming/copying.)

☐ 1. One for classified processing

☐ 2. _____ (number) for standard classified distribution

☒ 3. Two unclassified for processing

☐ 4. _____ (number) for program unclassified distribution

☒ 5. UC/C Category 122

☐ 6. Additional instructions/explanations _____

☐ 2. Classified (Standard Announcement only)

☐ 3. Special Handling (Legal basis must be noted below.)

☐ a. Unclassified Controlled Nuclear Information (UCNI)

☐ b. Export Control/ITAR/EAR

☐ c. Temporary hold pending patent review

☐ d. Translations of copyrighted material

☐ e. Small Business Innovation Research (SBIR)

☐ f. Commercializable information

☐ (1) Proprietary

☐ (2) Protected CRADA information

Release date / /

☐ (3) Other (explain) _____

☐ 4. Program Directed Special Handling (copy attached)

D. Releasing Official

A. Patent Clearance ("X" one)

☒ Has been submitted for DOE patent clearance

☐ DOE patent clearance has been granted

B. Released by _____

(Name) Herbert A. Tiedemann

(Signature)

(Phone) 918/337-4293

(Date) 1/4/96

C. Recommendation ("X" at least one)

☒ 1. Program/Standard Announcement/Distribution
(Available to U.S. and foreign public)

(Do not identify Sigma categories for Nuclear Weapons Data reports, and do not provide additional instructions that are inconsistent with C below.)

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