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City of Long Beach & Tidelands Oil Production Company

Award DE-FC22-95BC14934

**"INCREASING WATERFLOOD RESERVES IN THE WILMINGTON OIL  
FIELD THROUGH IMPROVED RESERVOIR CHARACTERIZATION AND  
RESERVOIR MANAGEMENT"**

**TIDELANDS OIL PRODUCTION COMPANY & CITY OF LONG BEACH  
CLASS III NEAR-TERM PROJECT**

**Quarterly Technical Progress Report**

Cooperative Agreement Number	DE-FC22-95BC14934
University/Institution/Laboratory	Tidelands Oil Production Company (TOPKO) City of Long Beach, Department of Oil Properties Stanford University Magnetic Pulse, Inc. (MPI)
Date of Report	July 26, 1995
Award Date	March 21, 1995
Anticipated Completion Date	Budget Period #1 : 3/20/97 Project Period : 3/20/00
Government Award	1995 \$936,664
Program Managers	Dennis Sullivan, City of Long Beach Don Clarke, City of Long Beach Scott Walker, Tidelands Oil Production Co.
Principal Investigators	Dennis Sullivan, City of Long Beach Don Clarke, City of Long Beach Scott Walker, Tidelands Oil Production Co. Chris Phillips, Tidelands Oil Production Co. John Nguyen, Tidelands Oil Production Co. Dan Moos, Stanford University Kwasi Tagbor, MPI
Contracting Officer's Representative	Edith Allison
Reporting Period	March 21, 1995 to June 30, 1995

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**Objectives :**

The objectives of this quarterly report are to summarize the work conducted under each task in the first quarter of 1995, and to report all technical data and findings as specified in the "Federal Assistance Reporting Checklist".

The main objective of this project is the transfer of technologies, methodologies, and findings developed and applied in this project to other operators of Slope and Basin Clastic Reservoirs. This project will study methods to identify sands with high remaining oil saturation and to recomplete existing wells using advanced completion technology.

The identification of the sands with high remaining oil saturation will be accomplished by developing a deterministic 3-D geologic model and by using a state of the art reservoir management computer software. The wells identified by the geologic and reservoir engineering work as having the best potential will be logged with a pulsed acoustic cased-hole logging tool. The application of the logging tools will be optimized in the lab by developing a rock-log model.

The wells that are shown to have the best oil production potential will be recompleted. The recompletions will be optimized by evaluating short radius and ultra-short radius lateral recompletions.

**Summary of Technical Progress :**

● **Budget Period 1, Activity 1 Reservoir Characterization**

The following progress has been made on developing rock-log and fluid-log models needed to calibrate acoustic log data which will be compared to theoretical expectations. Stanford has started laboratory measurements on plugs from existing core material. Strain measurements are under confining pressures to 4500 psi. They found bulk moduli of 2 Gpa for 10% strain are much lower than small strain dynamic moduli from dipole logging. They are making improvements in the lab equipment to facilitate both the static strain measurements and pulse transmission velocity determinations. Stanford successfully tested methods on synthetic rock physics data. Note - see Stanford Borehole Geophysics Laboratory Papers titled "Using Multipole Acoustic Logs In Cased Holes To Determine Porosity And Oil Saturation In Clastic Reservoirs" and "Laboratory Measurements Of The Physical Properties Of Unconsolidated Clastic Rocks" for further information.

Stanford has developed a full forward model to determine porosity and oil saturation from Vp and Vs along with applications to evaluate relationships

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between velocities, clay content, porosity, and saturations. This is an extension of previous work from the domain of clean arenites to rocks containing clay.

During the next quarter, work should continue on the rock-log and fluid-log models. We will run acoustic logs in 2 aquifer wells and 12 recompletion candidates and one new well.

● Budget Period 1, Activity 2 Reservoir Engineering

Tidelands has started researching open hole logs and cores from recent wells in Fault Block IV looking for high remaining oil saturation indicators. In general, we find particular sands watered out in a zone. For instance the "Z" sand of Upper Terminal Zone is very wet on all the logs we have examined. We are focusing our efforts on the Upper Terminal Zone. We have also analyzed wells with lower water cuts.

Injection and production data are almost all input into a workable database. These data are being quality controlled. We are managing approximately 603,140 records.

During the next quarter this database table will be exported to Production Analyst reservoir management software where we can develop waterflood patterns and relationships.

● Budget Period 1, Activity 3 Deterministic 3-D Geologic Modeling

Tidelands has neared completion in inputting directional surveys and quality controlling the sub-zone markers and fault picks for each well in the project databases. Tentative fault geometries have been verified for a first cut model on the Upper Terminal Zone. The City of Long Beach has manufactured several geologic cross sections of the Upper Terminal Zone across areas of initial interest. From these we have identified several production units. Production units are sands which are isolated and can be exploited from existing wells along with selective reperforation of idle penetrating wells.

During the next quarter we will continue building our model. A final cut model of the Upper Terminal Zone should be completed. Selection of the final recompletion candidates will be done and will be ready for acoustic logging.

● Budget Period 1, Activity 4 Pulsed Acoustic Logging

No activity to report.

During the next quarter we will log 2 aquifer wells for a base line response to water saturated sands, 1 new well open hole and cased hole to compare and

understand the difference in responses, and 12 recompletion candidates.

● Budget Period 1, Activity 5 Recompletions

No activity to report.

No activity planned for the next quarter.

● Budget Period 1, Activity 6 Technology Transfer

Technical transfer activities related to the project since October, 1994 are as follows:

- a. Chris Phillips of Tidelands made a presentation on "The 3-D Deterministic Geologic Model" being developed for the project at the 1995 AAPG Pacific Section Meeting in San Francisco, CA. on May 3-5. Don Clarke and Mike Henry of the City were co-authors.
- b. An article was submitted by Scott Hara of Tidelands on the City's and Tidelands' two DOE Class III Projects and published in the March, 1995 issue of Petroleum Engineer International magazine.
- c. Tidelands submitted a letter to Assistant Secretary Patricia Godley of the Office of Fossil Energy, U. S. DOE on March 3, 1995 supporting the Federal R&D programs generally and the DOE Class Reservoir Program specifically. The USC Petroleum Engineering Program also submitted a similar letter of support on March 1, 1995.
- d. An article which quoted James Hemphill of the City on the City's and Tidelands' two DOE Class III Projects was published in the October 10, 1994 edition of the Long Beach Press - Telegram newspaper.
- e. An article on the City's and Tidelands' two DOE Class III Projects was published in the October, 1994 issue of the SPE Los Angeles Basin Section Newsletter.
- f. Scott Hara of Tidelands sent out letter to California Coastal members of AAPG on January 10, 1995 announcing our DOE projects and to contact him to be placed on a mailing list of future technical transfer activities.
- g. Stanford, Tidelands Oil, and MPI presented an SPE paper (#29655) titled "Field Test of Acoustic Logs Measuring Porosity and Oil Saturation in a Mature Waterflood in the Wilmington Field, CA" at the 1995 SPE Western Regional Meeting in Bakersfield, California during March 8-10, 1995.

- h. Stanford placed a "home page" of the SPE paper on the World Wide Web on-line access via the Ethernet.
- i. Dan Moos of Stanford was in New Orleans on May 18th speaking at the Society of Professional Well Log Analysts (SPWLA).
- j. Tidelands hosted other Class III program participants at a meeting to coordinate joint participation on specific technical transfer activities on May 15, 1995 at Valencia, California.
- k. Stanford presented papers titled "Multipole Acoustic Logs In Cased Holes To Determine Porosity And Oil Saturation In Clastic Reservoirs" and "Laboratory Measurements Of The Physical Properties Of Unconsolidated Clastic Rocks" for the annual Stanford Rockphysics and Borehole Geophysics Consortium Meeting held at Stanford on June 19, 1995.

During the next quarter, work will continue on Society of Petroleum Engineering and American Association of Petroleum Geologists papers and presentations.

● Budget Period 1, Activity 7 Project Management

Steering committee meetings were held in May, June, and July. Note - see enclosed minutes.

During the next quarter Steering Committee Meetings will continue to be held monthly.

Executive Committee meetings were held in May and July. Note - see enclosed minutes.

During the next quarter Executive Committee Meetings will be conducted as needed.

References and Publications :

*Removed for separate cycling LG* SPE paper (#29655) titled "Field Test of Acoustic Logs Measuring Porosity and Oil Saturation in a Mature Waterflood in the Wilmington Field, CA" by Dan Moos, Stanford University, Scott Hara, Chris Phillips, Tidelands Oil Production Company, Andrew Hooks, Kwasi Tagbor, Magnetic Pulse Incorporated.

Stanford Rock and Borehole Geophysics paper titled "Multipole Acoustic Logs In Cased Holes To Determine Porosity And Oil Saturation In Clastic Reservoirs" by Daniel Moos.

Stanford Rock and Borehole Geophysics paper titled "Laboratory Measurements Of The Physical Properties Of Unconsolidated Clastic Rocks" by Carl Chang, Dan Moos, and Mark D. Zoback.



**MINUTES OF THE EXECUTIVE COMMITTEE MEETING  
FOR THE DOE WATERFLOOD & STEAMFLOOD PROJECT**

Held at Tidelands Oil Production Company, 301 East Ocean Boulevard, Suite #300,  
Long Beach, California, Tuesday, May 9, 1995 at 2:00 P.M. P.D.S.T.

Present for the meeting:

Ray Rockoff  
Xen Colazas  
James Hemphill  
Marina Voskanian  
Terry Smith  
Jim Quay  
Mark Kapelke  
Don Burns  
Scott Hara  
Scott Walker  
Don Foster

City of Long Beach Financial Mgmt  
City of Long Beach DOP  
City of Long Beach DOP  
State Lands Commission  
Tidelands Oil Production Company  
Tidelands Oil Production Company  
Tidelands Oil Production Company  
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Tidelands Oil Production Company

Mr. Xen Colazas presided as Chairperson.

Mr. Colazas welcomed everyone to the first Executive Committee meeting for the DOE Waterflood and Steamflood projects. Mr. Colazas stated that the Committee will be meeting once-a-month until both projects are completed. Mr. Colazas informed the Committee that it is the duty of the Executive Committee to oversee both projects and direct the Project Managers how they are to proceed with their prospective projects and to ensure that all requirements of the Cooperative Agreement are met. The Project Managers are Scott Walker for the waterflood and Scott Hara for the steamflood. Mr. Colazas also informed the Committee that it is their duty to direct Mr. Don Foster on the financial aspects and to ensure that each project is staying within the budget.

Mr. Scott Walker, Waterflood Project Manager, presented the minutes of the Steering Committee held on April 24, 1995.

Mr. Walker stated that even though Budget Period 1 is specified as 24 months in the Co-op Agreement, the work should to be completed in 18 months. Stanford performed work outside of the indicated work schedule in Budget Period 1 of which costs will be absorbed by Stanford.

Mr. Walker stated that during Budget Period 1 most of the technical work will be completed in Activities 1, 2, and 3. An overview of each activity was read from the Minutes of the Steering Committee (see copy attached).

Mr. Don Foster commented that it is too early in the Budget Period to provide a cost comparison of actual costs to budgeted costs.

Mr. Ray Rockoff explained that the City will try to receive funding at the same time Tidelands payables become due. A normal turn-a-round time from request of funds from DOE to reimbursing Tidelands is 7 to 10 days.

Mr. Scott Hara, Steamflood Project Manager presented the minutes of the Steering Committee held on April 6, 1995, April 18, 1995, and May 2, 1995.

Mr. Hara stated that 16 presentations have been made in relation to Activity 7 - Technology Transfer, since October 1, 1994. The steamflood project has 8 activities that will be completed during the course of the award. The compilation of data on the computer for Activity 1 will be completed by the end of this month. The data will date back to 1939.

USC will start the reservoir engineering by June 1, 1995. Four new wells will be drilled. Once the wells are drilled, tracer surveys will be initiated. Hot water alternating steam flooding has already been started. Five observation wells will be drilled starting in June. Chris Phillips is working on Deterministic 3-D Geologic Modeling. The Channel Crossing will be completed by September. The steam injection is currently scheduled to start on October 1, 1995.

Mr. Don Foster commented that it is too early in the Budget Period to provide a cost comparison of actual to budgeted costs. Total amount spent as of March 31, 1995, is \$93,000. The cost will accelerate in June when the drilling starts.

Mr. Xen Colazas stated that both projects are proceeding as expected with positive results. He stated that the Committee will meet again in the middle of June (date to be determined).

Mr. Colazas called the meeting adjourned at 3:15 P.M. P.D.S.T.

**MINUTES OF THE EXECUTIVE COMMITTEE MEETING  
FOR THE DOE WATERFLOOD & STEAMFLOOD PROJECT**

Held at Tidelands Oil Production Company, 301 East Ocean Boulevard, Suite #300,  
Long Beach, California, Wednesday, July 26, 1995 at 8:00 A.M. P.D.S.T.

Present for the meeting:

Ray Rockoff	City of Long Beach Financial Mgmt
James Hemphill	City of Long Beach DOP
Dennis Sullivan	City of Long Beach DOP
Terry Smith	Tidelands Oil Production Company
Jim Quay	Tidelands Oil Production Company
Mark Kapelke	Tidelands Oil Production Company
Don Burns	Tidelands Oil Production Company
Scott Hara	Tidelands Oil Production Company
Scott Walker	Tidelands Oil Production Company
Don Foster	Tidelands Oil Production Company

Mr. Mark Kapelke presided as Chairperson.

Mr. Scott Hara, Steamflood Project Manager stated that the highlights of the Project is the commencement of drilling conventional core holes and the drilling of the Channel Crossing.

Mr. Hara highlighted the Project task-by-task as follows:

- 1.1 Data compilation is in the quality control stages and should be completed by mid-August.
- 1.2 Seventy to eighty digitized logs have been given to USC for evaluation.
- 2.1 The basic reservoir engineering has started and, currently, data are being pulled together.
- 2.2 Currently evaluating non-radioactive tracers. Three observation wells have been drilled. Presently drilling the first core hole.
- 2.3 Chris Phillips with Tidelands has completed the deterministic model.
- 2.4 Work has just started on the stochastic model, not enough activity to report anything.
- 3.1 Evaluating software from Scientific Software.
- 4.1 Well programs are at the City for approval of surface location and drilling procedures.

- 4.4 Hot water alternating steam (WAS) has commenced. Hot water injection rates were increased this week to 3500/bbls.
- 5.1 Dave Davies is continuing lab work.
- 7. All requirements are being met under Activity 7. A multi-media CD Rom is being considered for use over the Internet for both the steamflood and waterflood project.

Mr. Don Foster stated that the project is on budget. In June \$812,000 was spent on piping and casing.

Mr. Scott Walker, Waterflood Project Manager, presented the minutes of the Steering Committee held on July 21, 1995. An overview of each activity was read from the Minutes of the Steering Committee (see copy attached).

The highlights of the project were discussed including the continuing lab work from Stanford and the preparation of idle wells for logging. MPI will be logging the first wells with their pulsed acoustic tool next week.

Mr. Don Foster commented that it is too early in the Budget Period to provide a cost comparison of actual costs to budgeted costs.

Mr. Kapelke called the meeting adjourned at 9:00 A.M. P.D.S.T.

## TIDELANDS OIL PRODUCTION COMPANY

DATE: April 24, 1995

SUBJECT: MINUTES OF THE D.O.E. NEAR-TERM WATERFLOOD PROJECT  
STEERING COMMITTEE MEETING

### ● ADMINISTRATIVE

- 1) Budget Period 1 is specified as 24 months in the Co-op agreement. We will still attempt to complete our work in the originally proposed 18 month time frame.
- 2) Stanford has absorbed the costs which fell outside the Co-op budget period.

### ● TECHNICAL

#### Activity 1 - Reservoir Characterization

- 1) Well 169-W is scheduled to be drilled in July. This is a an opportunity to get a cased hole & open hole suite of logs as well as a core in the Upper Terminal Zone, FB 4. This will give us vital information on in-situ fluid saturations and pore structure which will help build our rock-log and fluid-log models.
- 2) Stanford has cut plugs and started bulk modulus testing.
- 3) Logging of the aquifer wells with Schlumberger and MPI will be co-ordinated with the logging of 169-W. Two (2) aquifer wells are scheduled for this operation. Candidates need to be selected.

#### Activity 2 - Reservoir Engineering

- 1) Production and Injection data for the fault block has been inputted into the computer. It now needs to be quality controlled.

#### Activity 3 - Deterministic 3-D Geologic Modeling

- 1) Work on the 3-D deterministic model has not started. After the AAPG meeting Chris Phillips will start modeling areas of Upper Terminal FB4 where we have tentatively selected recompletion candidates and where 169-W penetrates the zone.
- 2) Surveys are continuing to be inputted into Newilma Database.

#### Activity 4 - Magnetic Pulse Logging

- 1) Nothing to report.

#### Activity 5 - Drilling & Recompletions

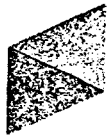
- 1) Nothing to report.

#### Activity 6 - Technology Transfer

- 1) Tidelands and Stanford presented a paper at the SPE Western Regional Meeting in Bakersfield in March concerning the initial results from well M-499.
- 2) Tidelands and Stanford will be giving presentations at the American Association of Petroleum Geologists (AAPG) in May in San Francisco. City of Long Beach is chairing the session.
- 3) Stanford placed a "home page" of the SPE paper on the World Wide Web on-line access via the Ethernet.
- 4) Dan Moos of Stanford will be in New Orleans on May 18th speaking at the Society of Professional Well Log Analysts (SPWLA).
- 5) Dan Moos of Stanford will be giving a presentation at the annual Stanford Rock and Borehole Geophysics Consortium Meeting June 19-21st.
- 6) City of Long Beach and Stanford are tentative chairs at the National AAPG meeting in San Diego to be held in May 1996.

#### Activity 7 - Project Management

- 1) Executive Committee meeting set for May 9th.
- 2) Next monthly Steering Committee meeting TBD.



# TIDELANDS

## OIL PRODUCTION COMPANY

OFFICE (310) 436-9918 FAX (310) 495-1950  
GENERAL ENGINEERING CONTRACTOR  
CALIFORNIA STATE LICENSE NUMBER 681859

DATE: June 12, 1995

SUBJECT: MINUTES OF THE D.O.E. NEAR-TERM WATERFLOOD PROJECT  
STEERING COMMITTEE MEETING FOR MAY 1995.

### ● ADMINISTRATIVE

Nothing to report

### ● TECHNICAL

#### Activity 1 - Reservoir Characterization

- 1) Well 169-W is scheduled to be drilled in September, not July as previously reported. This is an opportunity to get a cased hole & open hole suite of logs as well as 60' of conventional core in the Upper Terminal Zone, FB 4. This will give us vital information on in-situ fluid saturations and pore structure which will help build our rock-log and fluid-log models.
- 2) Logging of the aquifer wells with Schlumberger and MPI tentatively scheduled for the end of July. Aquifer candidates are being reviewed.
- 3) Successfully tested methods on synthetic rock physics data. Completed laboratory measurements on two rock samples from Wilmington Field and continued instrument modifications for radial strain measurements.

#### Activity 2 - Reservoir Engineering

- 1) Production and Injection data are being reviewed and quality controlled.

#### Activity 3 - Deterministic 3-D Geologic Modeling

- 1) Tentative fault geometries have been verified for a first cut model.
- 2) Surveys from the M-800's wells are missing and we are attempting to locate them at other sources.
- 3) Quality controlling subzone geology picks.
- 4) Concentrating initial activity on Upper Terminal Zone.

#### Activity 4 - Magnetic Pulse Logging

- 1) Examined cased hole MPI logs recorded in the Wilmington Field. Data appears obscured by tube waves.

#### Activity 5 - Drilling & Recompletions

- 1) Nothing to report.

#### Activity 6 - Technology Transfer

- 1) Tideland and Stanford presented a paper at the American Association of Petroleum Geologists (AAPG) on May 5th in San Francisco. City of Long Beach chaired the session.
- 2) Dan Moos of Stanford spoke in front of the Society of Professional Well Log Analysts (SPWLA) on May 18th and also made presentations at Chevron and Texaco.
- 3) Dan Moos of Stanford prepared 2 papers for the annual Stanford Rockphysics and Borehole Geophysics Consortium Meeting.
- 4) Tideland hosted other Class III program participants at a meeting to coordinate joint participation on specific technical transfer activities on May 15th.

#### Activity 7 - Project Management

- 1) Executive Committee meeting to be determined
- 2) Next Steering Committee meeting TBD.





# TIDELANDS

## OIL PRODUCTION COMPANY

OFFICE (310) 436-9918 FAX (310) 495-1950  
GENERAL ENGINEERING CONTRACTOR  
CALIFORNIA STATE LICENSE NUMBER 681859

DATE: July 21, 1995

SUBJECT: MINUTES OF THE D.O.E. NEAR-TERM WATERFLOOD PROJECT  
STEERING COMMITTEE MEETING FOR JUNE 1995.

### ● ADMINISTRATIVE

Nothing to report

### ● TECHNICAL

#### Activity 1 - Reservoir Characterization

- 1) Update : Well 169-W is scheduled to be drilled in late August. This is an opportunity to get a cased hole & open hole suite of logs as well as 60' of conventional core in the Upper Terminal Zone, FB 4. This will give us vital information on in-situ fluid saturations and pore structure which will help build our rock-log and fluid-log models.
- 2) Logging of the aquifer wells with Schlumberger and MPI scheduled for the first week of August. We will be logging 2 aquifer candidates and 2 recompletion candidates.
- 3) Developed full forward model to determine porosity and oil saturation from Vp and Vs.

#### Activity 2 - Reservoir Engineering

- 1) Production and Injection data are still being reviewed and quality controlled. We are approximately 80% complete.

#### Activity 3 - Deterministic 3-D Geologic Modeling

- 1) Tentative fault geometries have been verified for a first cut model.
- 2) Surveys from the M-800's wells are missing and we are attempting to locate them at other sources.
- 3) Quality controlling subzone geology picks.
- 4) Production units are being identified in the Upper Terminal Zone.

- 5) Creating cross sections through Upper Terminal Zone.

Activity 4 - Magnetic Pulse Logging

- 1) Nothing to report.

Activity 5 - Drilling & Recompletions

- 1) Nothing to report.

Activity 6 - Technology Transfer

- 1) Dan Moos of Stanford presented papers for the annual Stanford Rockphysics and Borehole Geophysics Consortium Meeting.

Activity 7 - Project Management

- 1) Executive Committee meeting to be determined.
- 2) Next Steering Committee meeting week of August 1-5, 1995.