Increasing Waterflood Reserves in the Wilmington Oil Field Through Improved Reservoir Characterization and Reservoir Management

**Quarterly Report
January 1 - March 31, 1998**

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

Cooperative Agreement Number DE-FC22-95BC14934

Tidelands Oil Production Company (TOPKO), Long Beach, CA
City of Long Beach, Department of Oil Properties
Stanford University, Stanford, CA
Magnetic Pulse, Inc. (MPI), Houston, TX

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Reporting Period	January 1, 1998 to March 31, 1998

Objectives

The objectives of this quarterly report are to summarize the work conducted under each task during the reporting period January - March 1998 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 recompleting existing wells using advanced completion technology.

The identification of the sands with high remaining oil saturation will be accomplished by developing a deterministic three dimensional (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 cased-hole logging tools. The application of the logging tools will be optimized in the lab by developing a rock-log model. This rock-log model will allow us to translate measurements through casing into effective porosity and hydrocarbon saturation.

The wells that are shown to have the best oil production potential will be recompleted. The recompletions will be optimized by evaluating short radius lateral recompletions as well as other recompletion techniques such as the sand consolidation through steam injection.

Summary of Technical Progress

● Reservoir Characterization

Updating the Upper Terminal Zone Fault Block V structure maps based upon the data developed from the J-17 redrill.

● Reservoir Engineering

Researchers are evaluating candidate wells J-106 and J-79 which are completed in a deeper zone but pass through the Tar Zone, Fault Block 5, in the study area.

Researchers are also evaluating production from the first budget period recompletions.

● **Deterministic 3-D Geologic Modeling**

A review of the J-17 Logging While Drilling (LWD) response as it related to our geologic model showed several inconsistencies. Other data suggested our geologic model was accurate and the interpretation problem was due to the LWD algorithm. The interpretation algorithm was deemed too simplistic for the heterogeneity of the formation. Additional log data was gathered from surrounding wells and digitized for a new resistivity model.

The new algorithm uses pairs of curves and their separation. Researchers used an iterative process where the inputs to the mathematical model and geological model were changed until a proper fit was achieved. One of the limitations to the mathematical model is that it creates a simplified cross section from which the modeling program calculates the modeled curves. This cross section is not as accurate as the ones from EarthVision™ which are created from a 3-D geological model calculated from well data (FIGURE 1).

Researchers correlated the H_{x0J} and H_{x0B} markers for all the wells in the modeled area. The H_{x1} , H_{x0} , H_{x2} and H_x markers were also checked. Before drilling, due to time constraints, only the wells adjacent to the J-17 proposed well course and selected wells beyond those were originally correlated. The new data set was created and entered into an EarthVision™ data base. The exported data was then modeled.

The log signature on the recorded while drilling log (RWD) showed a fault at 3480'. A fault plane coincident with the fault pick, parallel and offset to the Maine Avenue fault was created. The Maine Avenue fault dips West and old map interpretations showed an extension curving toward the point where J-17 crossed the fault. When this West dipping fault was added to the structure, the resulting geological model was unsatisfactory. The fault was then rotated to dip East and incorporated into the structure. The shale layers above the H_{x0} and H_{x0J} were also included in the model. It should be noted that the fault was modeled with only 4' of displacement and no definitive electric log fault picks were identified.

Researchers studied the data further and created a second set of resistivity inputs for

the formation to the West of the fault. A second mathematical model was created and spliced to the first at the fault. As can be seen from the attached cross section (FIGURE 1), the modeled curves, RWD curves and the geology correlate nicely. The fact that the resistivity inputs had to be changed to create a second mathematical model, to accurately depict the formation west of the fault, is an indication of the heterogeneity of the formation. The inputs are based on the offset wireline logs, vertical and horizontal resistivity response extracted from the RWD log and changes noted from the geological model. We suspected a lithologic and saturation change before drilling and the Anisotropic inversion modeling agreed well with this.

● Cased Hole Logging

No cased hole logging took place.

● Recompletions

Budget period one horizontal redrill candidate J-17 was started in early March 1997. The liner was perforated with 0.74 cm (0.29") holes, 0° phased, and spaced one (1) hole per ten (10) foot interval from 1001 m (3285') to 1189 m (3900'). A string of thermal insulated tubing with a thermal packer on bottom were installed. A total of 8,556 m³ (53,817 bbls) of cold water equivalent steam was injected into the well in order to consolidate the sand. The well is currently shut in and soaking and is anticipated to be on production in the next quarter.

● Technology Transfer

A paper was accepted to the Society of Professional Well Log Analysts (SPWLA) 39th Annual Logging Symposium titled "Determination and Application of Formation Anisotropy using Multiple Frequency, Multiple Spacing Propagation Resistivity Tool from a Horizontal Well, Onshore California" for a presentation that will be given in Keystone, Colorado in May, 1998.

References and Publications

None

CROSS SECTION ALONG J-017 4 WELL COURSE