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Report Title:	Increasing Heavy Oil Reserves in the Wilmington Oil Field Through Advanced Reservoir Characterization and Thermal Production Technologies
Report Type:	Annual
Reporting Period Start Date:	04/01/2005
End Date:	03/31/2006
Principal Author(s):	Scott Hara
Report Issue Date:	08/01/2006
DOE Award No.:	DE-FC22-95BC14939
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Project Summary Page

INCREASING HEAVY OIL RESERVES IN THE WILMINGTON OIL FIELD THROUGH ADVANCED RESERVOIR CHARACTERIZATION AND THERMAL PRODUCTION TECHNOLOGIES

Cooperative Agreement No.: DE-FC22-95BC14939

Contractor Names: City of Long Beach Department of Oil Properties (City) and Tidelands Oil Production Company (Tidelands), Long Beach, CA.

Award Date: March 30, 1995

Anticipated Completion Date: September 30, 2003 Budget Period 1
March 31, 2007 **Budget Period 2**

DOE Award: $6,685,458 (Cum Actual through Budget Period 1)
$0 (Remaining funds in BP 1)
$412,200 (Actual BP2 Funds expended 4/1/05-3/31/06)
$425,327 (Cum Actual BP2 through March 2006)
$781,028 (Remaining funds in BP 2)

Principal Investigator: Scott Hara – Tidelands Oil Production Company

Program Manager: James Barnes - National Energy Technology Laboratory

Type of Report: **Annual Technical Progress Report**

Date of Report: August 1, 2006

Reporting Period: **April 1, 2005 to March 31, 2006**

Abstract

The overall objective of this project is to increase heavy oil reserves in slope and basin clastic (SBC) reservoirs through the application of advanced reservoir characterization and thermal production technologies. The project involves improving thermal recovery techniques in the Tar Zone of Fault Blocks II-A and V (Tar II-A and Tar V) of the Wilmington Field in Los Angeles County, near Long Beach, California. A primary objective is to transfer technology that can be applied in other heavy oil formations of the Wilmington Field and other SBC reservoirs, including those under waterflood.

The first budget period addressed several producibility problems in the Tar II-A and Tar V thermal recovery operations that are common in SBC reservoirs. A few of the advanced technologies developed include a three-dimensional (3-D) deterministic geologic model, a 3-D deterministic thermal reservoir simulation model to aid in reservoir management and subsequent post-steamflood development work, and a detailed study on the geochemical interactions between the steam and the formation rocks and fluids. State of the art operational work included drilling and performing a pilot steam injection and production project via four new horizontal wells (2 producers and 2 injectors), implementing a hot water alternating steam (WAS) drive pilot in the existing steamflood area to improve thermal efficiency, installing a 2400-foot insulated, subsurface harbor channel crossing to supply steam to an island location, testing a novel alkaline steam completion technique to control well sanding problems, and starting on an advanced reservoir management system through computer-aided access to production and geologic data to integrate reservoir characterization, engineering, monitoring, and evaluation.

The second budget period phase continues to implement state-of-the-art operational work to optimize thermal recovery processes, improve well drilling and completion practices, evaluate the geomechanical characteristics of the producing formations, and update the 3-D geologic and reservoir simulation models. The objectives are to further improve the characterization of the heterogeneous turbidite sands, identify the high permeability thief zones to reduce water breakthrough and cycling, and analyze the nonuniform distribution of the remaining oil in place. This work is resulting in the redevelopment of the Tar II-A and Tar V post-steamflood projects by drilling a few new wells and converting idle wells to improve sweep efficiency and more effectively drain the remaining oil reserves. Proper reservoir management will reduce water cuts while minimizing further thermal-related formation compaction. The project will utilize all the tools and knowledge gained throughout the DOE project to maximize recovery of the oil in place.

<u>The Project Team Partners include the following organizations:</u>

1. The City of Long Beach - the operator of the field as Trustee of the State of California-granted tidelands;

2. Tidelands Oil Production Company - the contract operator of the field for the City of Long Beach, and the party in charge of implementing the project;
3. The University of Southern California, Petroleum Engineering Program - consultants to the project, playing a key role in reservoir characterization and simulation;
4. GeoSystems, formerly David K. Davies and Associates - consultants to the project regarding petrography, rock-based log modeling, and geochemistry of rock and fluid interactions; and
5. Stanford University, Petroleum Engineering Department - consultants to the project, performing laboratory research on sand consolidation well completion processes.

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List of Graphical Materials (cont'd)

Executive Summary

The project involves using advanced reservoir characterization and thermal production technologies to improve thermal recovery techniques and lower operating and capital costs in a slope and basin clastic (SBC) reservoir in the Wilmington field, Los Angeles Co., California. Budget Period 1 (BP1) ended on September 30, 2003. The project team received DOE BP2 contract approval on May 18, 2004 with the BP2 effective dates from October 1, 2003 to March 31, 2007. This annual report covers the period from April 1, 2005 to March 31, 2006.

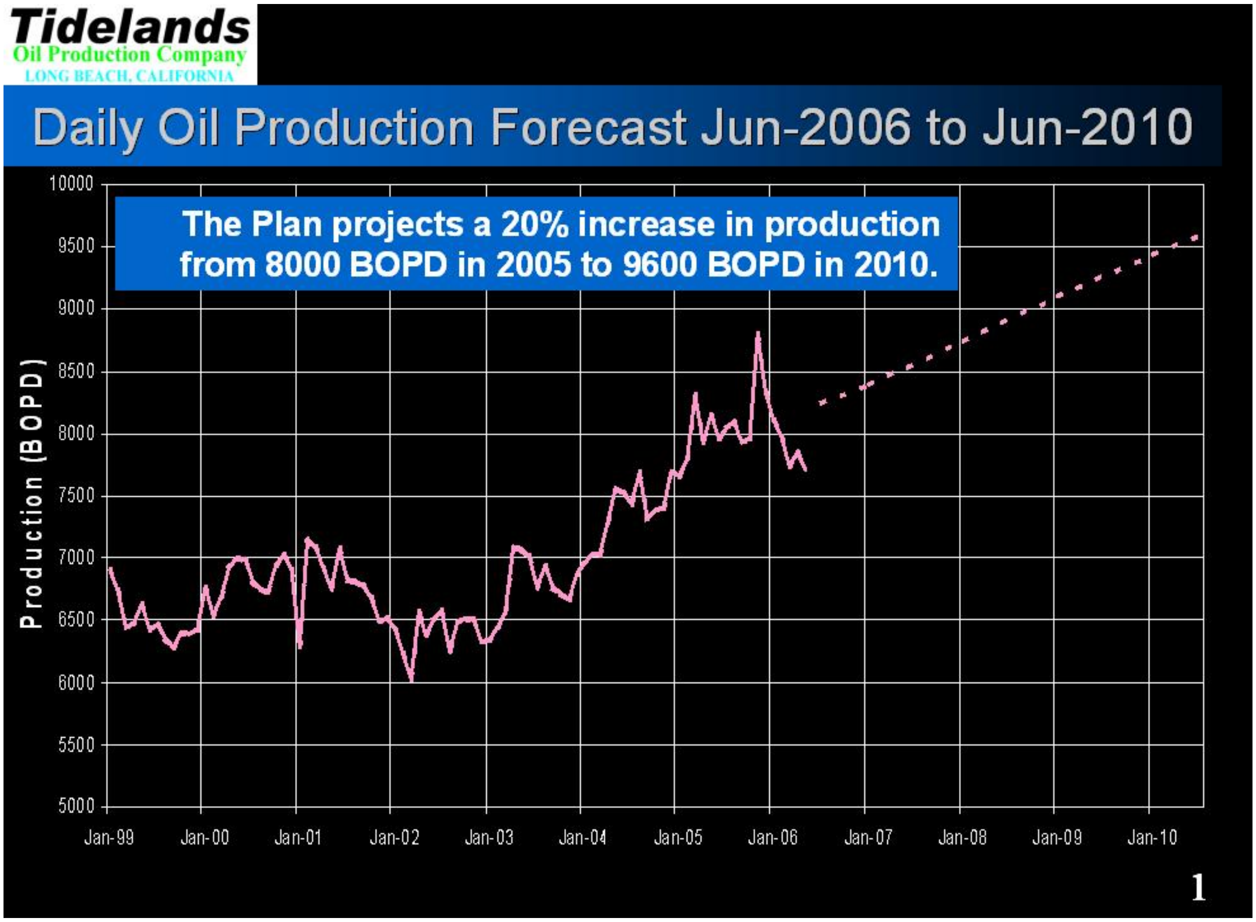
Tidelands is experiencing the most successful drilling in 25 years at the Wilmington onshore oil field area owned by the City of Long Beach. After Tidelands' operated Wilmington field oil production dropped to a low of 6100 BOPD in March 2002, a drilling program was started in 2003 to increase production based on what we learned from Tidelands' two Class III DOE projects (DE-FC22-95BC14939 and DE-FC22-95BC14934). Since 2003, Tidelands has drilled 34 producers and 6 water injectors and has increased total oil production from 6100 BOPD in March 2002 to 7738 BOPD in March 2006. Tidelands plans to drill 15 producers and 7 water injectors in the latter half of 2006 and early 2007. The 34 producers had peak production rates totaling 7974 barrels of oil per day (BOPD) and 45,071 barrels of daily gross fluid (BGFPD; 82% water cut) compared to the projected first year average rates of 3207 BOPD and 46,125 BGFPD (93% water cut). The 34 producers as of March 31, 2006 have been active from 2 months to 3 years and production well test rates total 2431 BOPD and 51,187 BGFPD (95.3% water cut). The 2431 BOPD represents 31% of Tidelands' 7738 BOPD operated production in March 2006. The best wells have been drilled to the Fault Block 3 Upper Terminal zone in an area the City of Long Beach had almost given up on as depleted. Initial well rates have ranged from 159 – 1048 BOPD and March 2006 production tests from the five wells are 504 BOPD.

The drilling results are particularly encouraging since the portion of the Wilmington Field that Tidelands operates has been on production since the 1930's, was completely developed by the 1950's and has been waterflooded since 1953. The average water cut is 96.7% and the natural decline is about 8% per year. Tidelands has recently been drilling three types of production wells: selective completions, horizontal wells and fracture stimulated wells. Our success with the first two types of production wells, selective completions and horizontal wells, are a direct result of the work that Tidelands completed under the DOE Class III projects.

Figure 1 shows Tidelands' operated Wilmington field oil production since 2001 and our projected production to 2010. Production is expected to increase 20% from 8000 BOPD in 2005 to 9600 BOPD in 2010 assuming continued drilling of about 15 producers annually.

The project team was very active this period in our Wilmington Field DOE thermal projects. Operationally, the Fault Block II-A Tar Zone post-steamflood (Tar II-A)

project is being redeveloped and the Tar V pilot post-steamflood project has continuing development drilling and well workovers.



Tidelands drilled four wells, producers UP-958, UP-959 and W-900 and injector 2AT-64, from October 2004 to February 2005 into the Tar II-A post-steamflood project to replace four producers and one injector plugged and abandoned to accommodate the Port of Long Beach. The three producers peaked at 490 BOPD and 6106 BPD gross fluid and later produced only 208 BOPD and 4322 BPD gross fluid in March 2006 compared to the 345 BOPD average in the first quarter 2005 from the original four wells. Six idle steam injection wells in the Tar II-A project were activated in 2005 by converting three to producers (AT-42, AT-43 and AT-63) and three to water injectors (2AT-21, 2AT-22, 2AT-23). Producer well UP-927 had a major workover in 2005 to repair an inner liner. The four producers peaked at 221 BOPD and 6092 BGFPD (96% water cut). Wells AT-42 and AT-43 watered out and the two remaining wells produced 102 BOPD and 2758 BPD gross fluid in March 2006. Two of the three injection wells were successfully placed on water injection while the third well had casing damage and was idled. Tidelands drilled and completed a horizontal Tar zone producer, well UP-961, in late 2005 to test downdip, cold heavy oil waterflood production and a vertical infill pattern well, UP-960, in early 2006 to delineate the remaining oil saturations in a steamflooded and hot waterflooded pattern. Well UP-961 peaked at 185 BOPD and

635 BGFPD in November 2005 and produced 106 BOPD and 1432 BGFPD in March 2006. Well UP-960 came on production in late January and peaked at 70 BOPD and 1328 BGFPD in March 2006.

The City and Tidelands began assembling a new round of temperature surveys and Schlumberger Reservoir Saturation Tool (RST) logs in several idle wells within the Tar II-A steamflood area from the second half of 2005 to early 2006. The temperature surveys were run to determine reservoir temperature changes and heat movement through the T and D1 steamflood sands from the start of the post-steamflood phase in January 1999 through February 2006. The steamflood sands continue to cool slowly at the top of the sands but have experienced accelerated cooling at the bottom of sands due to water injection and gravity segregation. Temperatures in the shales between the T and D sands have risen through heat transfer from the much hotter rocks above and below, which could make the shales susceptible to formation compaction. Preliminary analysis of the RST logs indicates zero to possibly a few feet of Tar zone compaction from the top of the S subzone to the top of the Ranger F subzone in certain areas within the former steamflood area.

The Tar V post-steamflood pilot project experienced an increase in oil production from two new horizontal wells, wells A-603 and A-115, at the top of the S4 sands outside the steamflood pattern in cold oil. Well A-603 was drilled and completed in March 2005 and the well peaked at a surprisingly high rate of 412 BOPD and 781 BPD gross fluid. The well has continued to produce at high oil rates throughout the period, with oil production at 215 BOPD in March 2006. Well A-115 was drilled and completed in October 2005 to follow-up successful well A-603. Well A-115 peaked at 221 BOPD and 965 BPD gross fluid and production during March 2006 was 138 BOPD and 1868 BPD gross fluid. The offset operator, Thums Long Beach Company, intends to drill similar Tar S sand horizontal wells in fault block V in 2006 based on Tidelands success. Tar V horizontal pilot steamflood producer J-205 was plugged out of the horizontal section because it watered out from post-steamflood water injection and was recompleted at the top of the S_4 sands in the highly deviated portion of the well in July 2005. Production from J-205 in August 2005 was 35 BOPD and 706 BPD gross fluid and in March 2006 was 16 BOPD and 1002 BPD gross fluid.

Stanford researchers completed their contract work injecting hot alkaline fluid into formation cores and quart sand vessels to determine if they could duplicate the sand-consolidation empirical process from the field in the laboratory. Initial results did not generate the expected calcium silicate cements. The experimental design assumptions were reexamined, and further testing indicated the calcium silicate cements probably originated from dissolution of wellbore cements used in completing the well. Their results show that it may be possible to add calcium silicate to injected hot alkaline water to consolidate formation sands in a perforated well completion. A second phase of laboratory research should start in 2006 that will formulate and conduct experiments to optimize the geomechanical performance of the hot-alkaline-water sand consolidation process. Further laboratory work will lay the underpinnings to lower the costs of the sand consolidation method, enable the application of the sand consolidation method to deeper and higher-pressure reservoir intervals at Wilmington, and increase the rate of success of sand consolidation completions as well as the longevity of treatment.

Stanford delivered a paper on the results of their laboratory research on the sand consolidation well completion process in March 2005. This paper was peer-reviewed and published in the June 2006 issue of the *SPE Journal.* Tidelands and its partners presented three other papers in March; one about the success of new Tar II-A producing well UP-957 that was drilled in the First Quarter 2004; the second about a geologic and reservoir engineering model for the Wilmington Field Fault Block IV Terminal zones that quickly screens for new development well prospects by “visualizing” the reservoir drainage of each formation subzone; and the third about the development of internal combustion engines used in our oilfield operations that can burn variable low-quality BTU gas (rather than flaring) resulting in lower overall air pollutant emissions. The paper about the new Tar II-A horizontal well UP-957 was summarized and rewritten as a magazine article in the July 2006 issue of the American Oil and Gas Reporter,

Introduction

The objective of this project is to increase the recoverable heavy oil reserves within sections of the Wilmington Oil Field, near Long Beach, California. Several advanced reservoir characterization and thermal production technologies have been successfully tested during this project and implemented throughout the Wilmington Field. Research, testing and application of new technologies are continuing and technology transfer will be extended to increase the recoverable oil reserves at Wilmington and in other slope and basin clastic (SBC) reservoirs.

The first budget period phase addressed several producibility problems in the Tar II-A and Tar V thermal recovery operations that are common in SBC reservoirs. A few of the advanced technologies developed include a three-dimensional (3-D) deterministic geologic model, a 3-D deterministic thermal reservoir simulation model to aid in reservoir management and subsequent post-steamflood development work, and a detailed study on the geochemical interactions between the steam and the formation rocks and fluids. State of the art operational work included drilling and performing a pilot steam injection and production project via four new horizontal wells (2 producers and 2 injectors), implementing a hot water alternating steam (WAS) drive pilot in the existing steam drive area to improve thermal efficiency, installing an 2400-foot insulated, subsurface harbor channel crossing to supply steam to an island location, testing a novel alkaline steam completion technique to control well sanding problems, and starting on an advanced reservoir management system through computer-aided access to production and geologic data to integrate reservoir characterization, engineering, monitoring, and evaluation.

The Project Team will continue to implement state of the art operational work during the second budget period to optimize thermal recovery processes, improve well drilling and completion practices, evaluate the geomechanical characteristics of the producing formations, and update the 3-D geologic and reservoir simulation models. The objectives are to further improve the characterization of the heterogeneous turbidite sands and identify the high permeability thief zones and nonuniform distribution of the remaining oil. This work will result in redeveloped Tar II-A and Tar V post-steamflood projects by drilling a few new wells, converting idle wells to more effectively drain the remaining oil reserves, and performing well workovers on key wells. The project will utilize all the tools and knowledge gained through the DOE project to maximize recovery of the oil in place by improving sweep efficiency and reducing water cuts while minimizing further thermal-related formation compaction.

This report covers the period from April 1, 2005 to March 31, 2006. The project team was very active this period in our Wilmington Field DOE thermal projects. Operationally, the Fault Block II-A Tar Zone post-steamflood (Tar II-A) project is being redeveloped and the Tar V pilot post-steamflood project has continuing development drilling and well workovers.

Tidelands drilled four wells, producers UP-958, UP-959 and W-900 and injector 2AT-64, from October 2004 to February 2005 into the Tar II-A post-steamflood project to replace four producers and one injector plugged and abandoned to accommodate the Port of Long Beach. The three producers peaked at 490 BOPD and 6106 BPD gross fluid and produced only 208 BOPD and 4322 BPD gross fluid in March 2006 compared to the 345 BOPD average in the first quarter 2005 from the original four wells. The last annual report for the period ending March 31, 2005 highlighted how results from reservoir simulation modeling were applied to successfully drill a new Tar II-A horizontal producing well UP-957, which led to the follow-up drilling of horizontal wells UP-958 and W-900 and vertical reservoir delineation and infill pattern well UP-959.

Six idle steam injection wells in the Tar II-A project were activated in 2005 by converting three to producers (AT-42, AT-43 and AT-63) and three to water injectors (2AT-21, 2AT-22, 2AT-23). Producer well UP-927 had a major workover in 2005 to repair an inner liner. The four producers peaked at 221 BOPD and 6092 BGFPD (96% water cut). Wells AT-42 and AT-43 watered out and the two remaining wells produced 102 BOPD and 2758 BPD gross fluid in March 2006. Two of the three injection wells were successfully placed on water injection while the third well had casing damage and was idled. Tidelands drilled and completed a horizontal Tar zone producer, well UP-961, in late 2005 to test downdip, cold heavy oil waterflood production and a vertical infill pattern well, UP-960, in early 2006 to delineate the remaining oil saturations in a steamflooded and hot waterflooded pattern. Well UP-961 peaked at 185 BOPD and 635 BGFPD in November 2005 and produced 106 BOPD and 1432 BGFPD in March 2006. Well UP-960 came on production in late January and peaked at 70 BOPD and 1328 BGFPD in March 2006.

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ACTIVITY 1.2
BASIC RESERVOIR ENGINEERING and 3-D DETERMINISTIC RESERVOIR SIMULATION MODELING

Tar II-A Post-Steamflood Project

The Tar II-A post-steamflood project underwent a reservoir cooling and oil recovery acceleration strategy starting in mid-2002 that has continued through the current reporting period. Several long-term idle wells were activated or converted as producers or water injectors, the Port of Long Beach replaced six wells, and three new producers were drilled. The net result of the program has been that oil production increased less than 10% or less than 100 BOPD while gross production increased by about 16,000 BPD or over 75%. Water injection increased about 14,000 BPD in the same time frame. The program caused premature water breakthrough in many producing wells and resulted in more well work and downtime. Oil production fluctuated from well drilling and idle well activations and once increased to over 1400 BOPD in November 2005, but would repeatedly decline and stabilize at about 1100 BOPD. Reservoir cooling did accelerate, but at the cost of pumping significantly higher water production and injection volumes while experiencing higher operating costs and little increase in oil production. Figure 2 is a Tar II-A steamflood pattern map showing the locations of the post-steamflood wells as of April 1, 2006, including new wells UP-957, UP-958, UP-959, UP-960, UP-961, W-900, and 2AT-64, abandoned wells UP-942, UP-941, UP-950, UP-939 and 2AT-62, and converted wells AT-42, AT-43, AT-63, 2AT-21, 2AT-22 and 2AT-23. Figure 3 is a production graph for the Tar II-A post-steamflood project from December 1998 to March 2006 showing oil and gross fluid production, water injection, and produced water – oil ratio. The oil production stream is annotated with the recent well work, new wells and well abandonments.

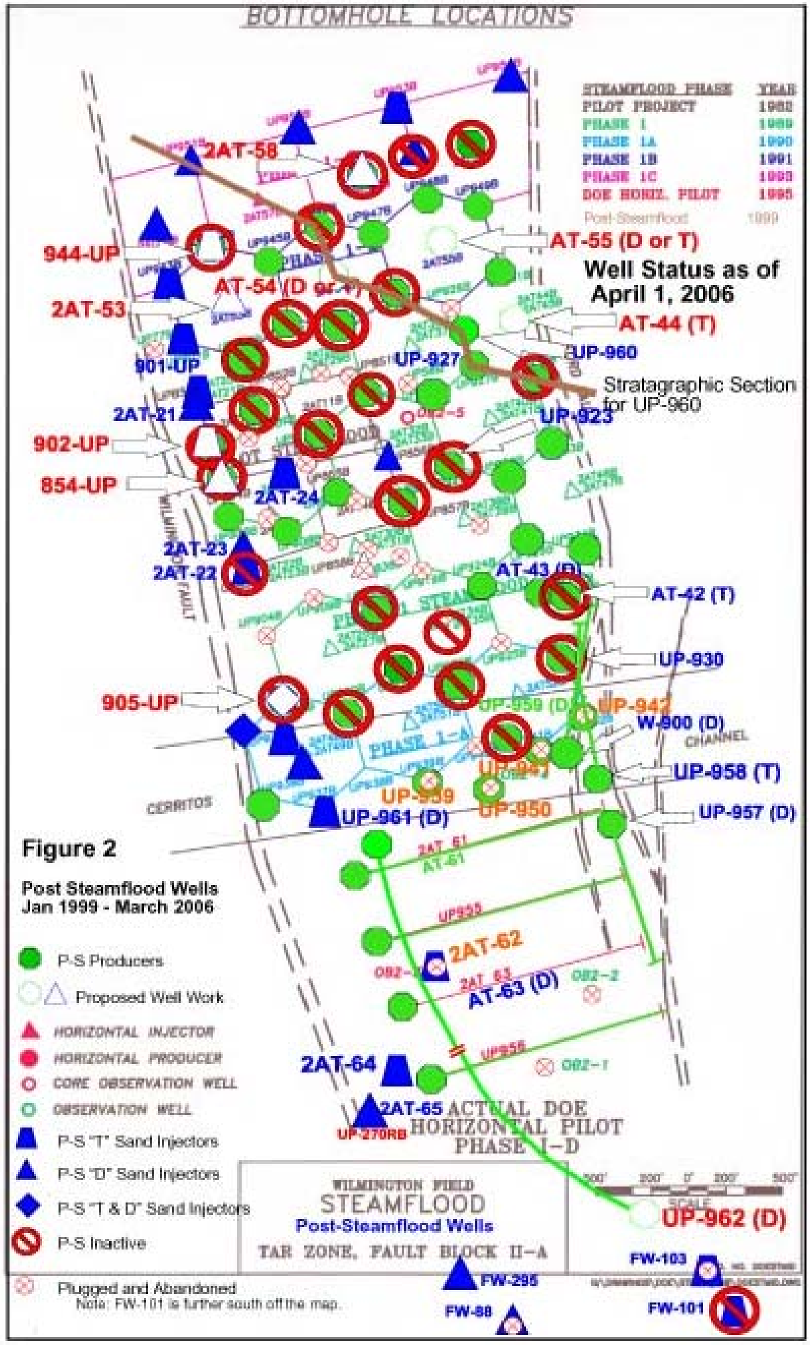


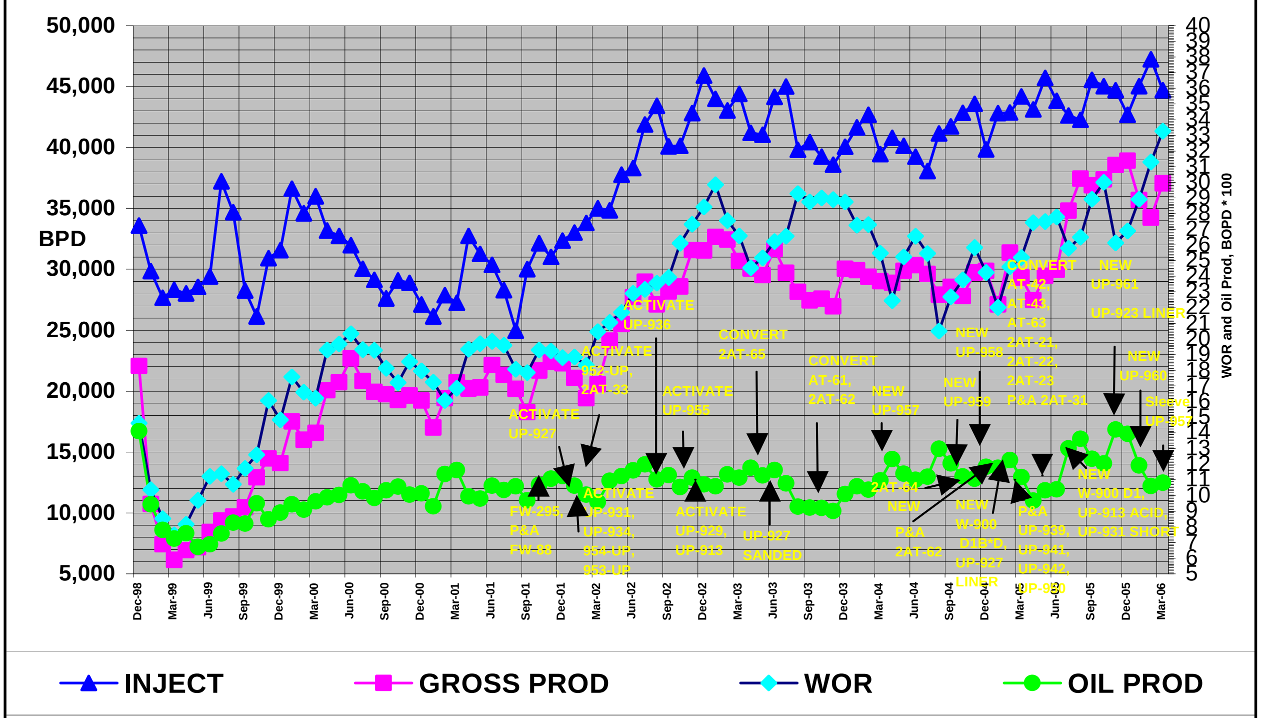
Figure 2
Post Steamflood Wells
Jan 1999 - March 2006

The Tar II-A production performance for the past two years is described below in annual segments. Also included is an analysis of horizontal producing well UP-957, which was drilled in 2004 based on the results of the most recent reservoir simulation model update performed in 2003 and affected the wells drilled afterwards.

April 2004 to March 2005 General Work

The Tar II-A post-steamflood project underwent major operational changes to accommodate the Port of Long Beach (POLB) container terminal expansion. The project had to plug and abandon four of the best producing wells totaling 345 BOPD and one T sand injection well. The POLB paid for three replacement producing wells (UP-958, UP-959 and W-900) and an injection well (2AT-64), which were drilled and activated from October 2004 to February 2005. The three replacement producers were initially proposed as the first three DOE BP2 wells to be drilled.

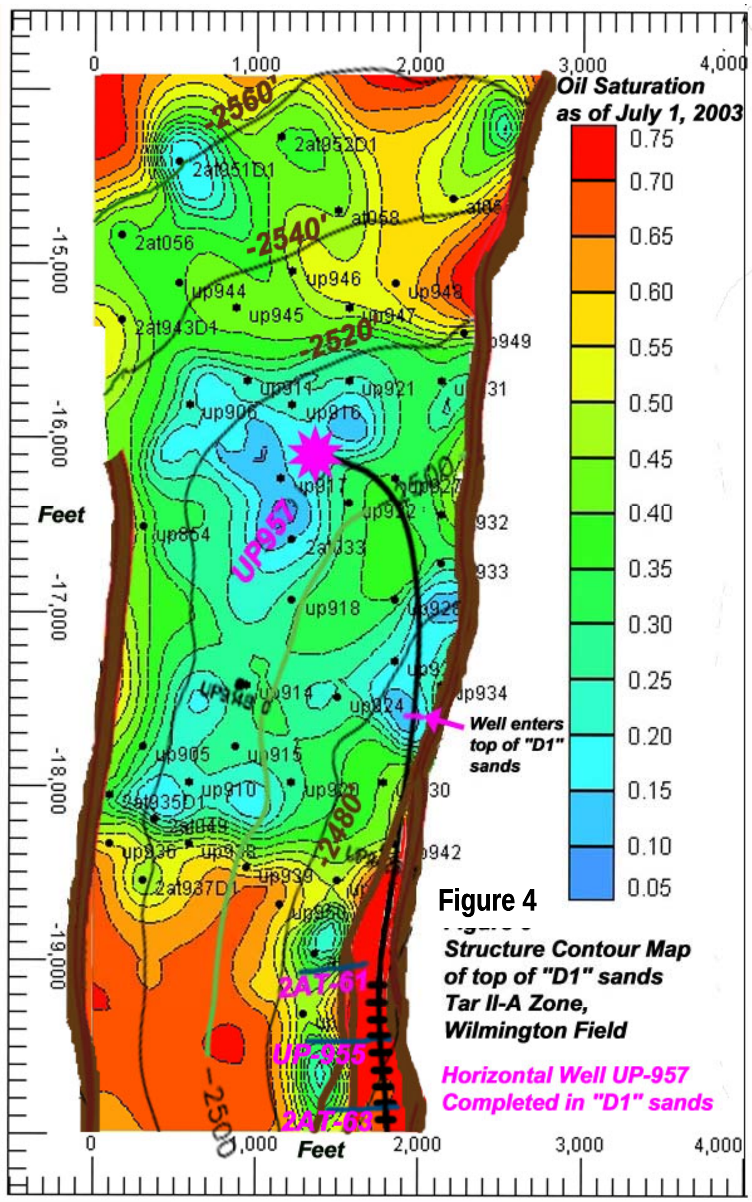
Figure 3: Tar II-A Post-Steamflood Performance



Tar II-A oil production from April 2004 to March 2005 averaged 1169 BOPD at a 4.01% oil cut (24.0 WOR), substantially better than in November 2003 when it averaged 902 BOPD at a 3.3% oil cut (28.9 WOR). The production increase was primarily due to adding well UP-957 and replacement wells UP-958, UP-959 and W-900 and repairing producer well UP-927.

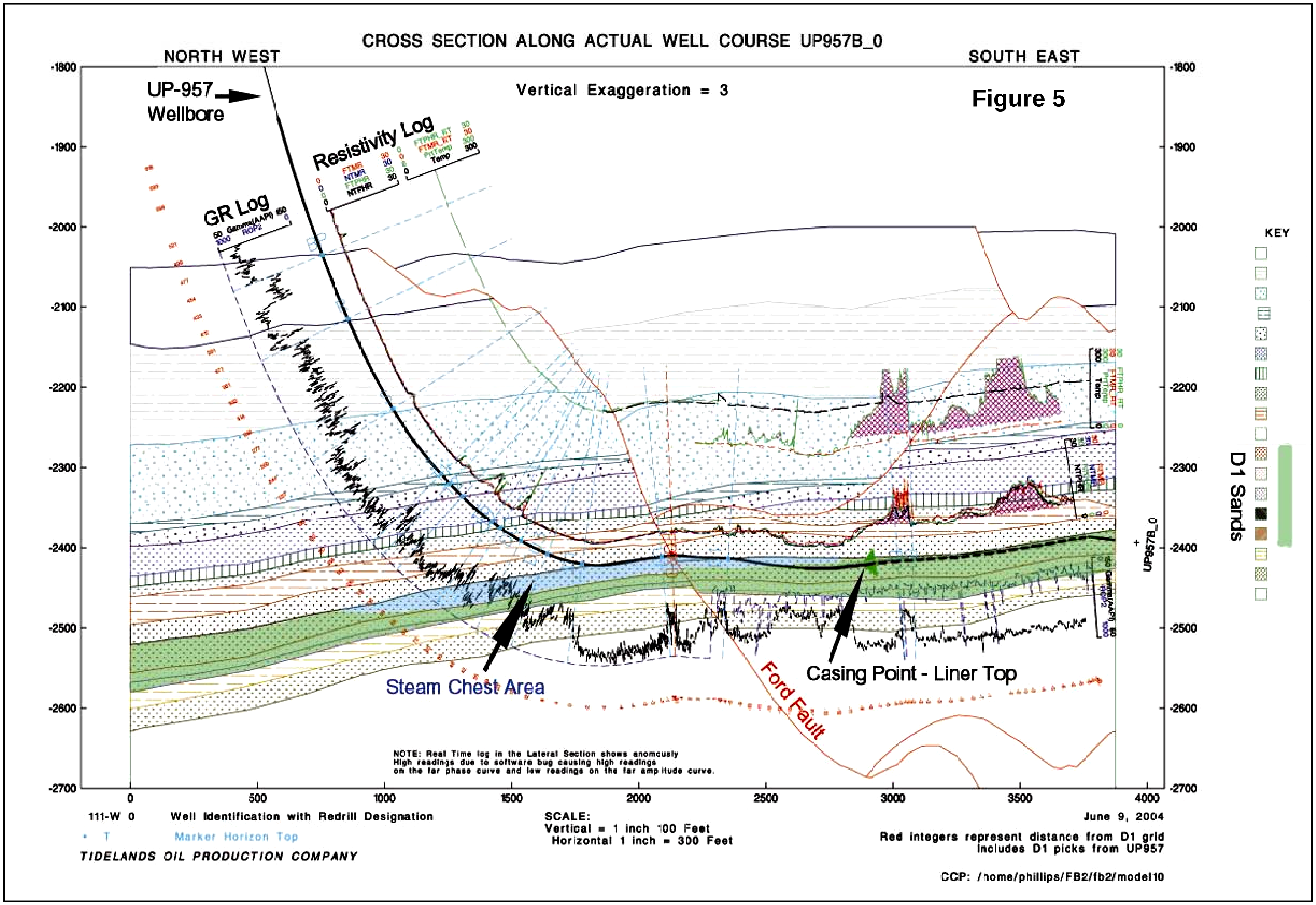
Reservoir Simulation Used for Development Drilling
Tar II-A Horizontal D1 Sand Production Well UP-957

The project team drilled new horizontal producing well UP-957 in March 2004 to recover stranded steamflood oil reserves at the top of the D1 sands within a fault splinter that the reservoir simulation model showed had the highest remaining Tar II-A oil saturations. The Ford Fault is not sealing where UP-957 crossed it, but it could be sealing further south where the displacement is greater and newer well log data revealed oil saturation differences on opposite sides. Figure 4 is a Tar II-A color-coded oil saturation map of the upper D1 sands as of July 2003 that includes geologic structure contour lines, the faults, and the well path for UP-957. Figure 5 is a cross-section of the actual well path through the D1 sands. The cross- section includes the resistivity and gamma ray logs, and highlights the oil-saturated D1 sands in green and the relatively oil-depleted D1 sands in blue based on log resistivity data.



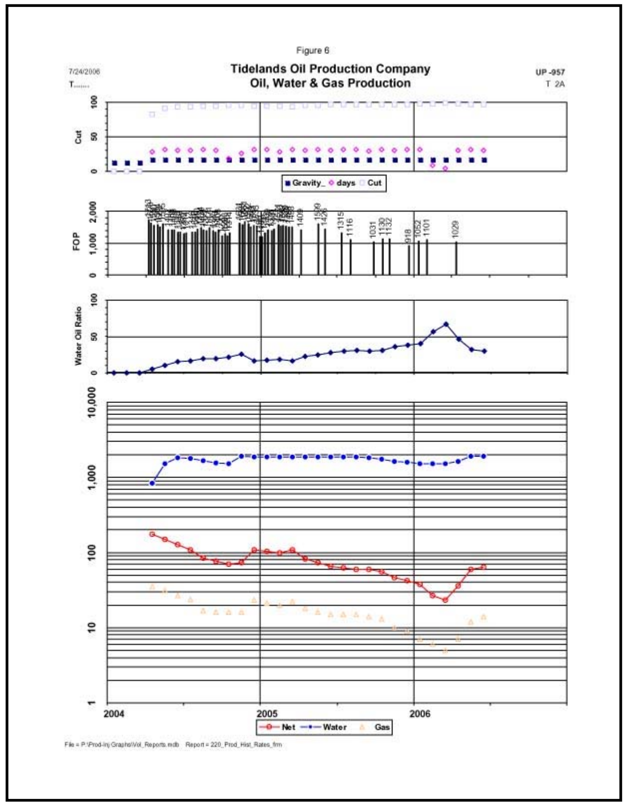
The well was completed with 845 ft of open-hole, gravel-packed, wire-wrapped screen on April 2, 2004 and reached peak oil production on April 6 of 249 BOPD (over 100% better than projected 100 BOPD) and 723 BPD gross fluid at 197°F at the wellhead and with a producing fluid level of 2,122 feet over the mid-perforation depth of 2,403 feet VSS. Gross fluid production was increased three times within the first two months to a maximum rate of 2,000 BPD. Following each gross fluid rate increase, oil production rose temporarily and then declined more rapidly than expected to 110 BOPD by December 2004, resulting in higher water cuts up to 94.5 percent (a maximum WOR of 17.2)–a nine-fold increase in eight months. Producing fluid levels decreased slightly during the first eight months, ranging from 1,800-2000 ft over the mid-perforation depth and the well experienced higher fluid temperatures at the wellhead (up to 256 degrees). The rising fluid temperatures and water cuts were attributed to the well drawing in hot water and oil from the steam chest area through the heel of the completion rather than the warm oil and water from the highly oil saturated sands. The gross fluid production during 2005 was maintained at 2,000 BPD and oil production declined to a stabilized rate of 60 BOPD by August 2005.

In November 2005, the well began to water out and oil production plummeted to 25 BOPD and 1560 BPD gross fluid by February 2006 for a 98.4% water cut and WOR of 61.5. A workover was performed in March 2006 to install a 705 ft tubing sleeve with dual packers to seal off the first 507 ft of open-hole completed section of wire-wrapped screen and 198 ft of casing-liner lap section. The objective was to isolate the heel section and produce from the cooler and higher oil saturated sands. Well production in March 2006 was set at 2000 BPD gross fluid and oil production stabilized at 60 BOPD



CROSS SECTION ALONG ACTUAL WELL COURSE UP957B_0
NORTH WEST
SOUTH EAST
Vertical Exaggeration = 3
Figure 5
UP-957 Wellbore
Resistivity Log
GR Log
Steam Chest Area
Casing Point - Liner Top
Ford Fault
D1 Sands
KEY
UP957B_0
NOTE: Real Time log in the Lateral Section shows anomously High readings due to software bug causing high readings on the far phase curve and low readings on the far amplitude curve.
111-W 0 Well Identification with Redrill Designation
T Marker Horizon Top
TIDELANDS OIL PRODUCTION COMPANY
SCALE:
Vertical = 1 inch 100 Feet
Horizontal 1 inch = 300 Feet
June 9, 2004
Red integers represent distance from D1 grid includes D1 picks from UP957
CCP: /home/phillips/FB2/fb2/model10

(97% water cut and WOR of 32.3) with fluid temperatures of 240°F and a producing fluid level of 1438 ft over the mid-perforation depth, which may indicate continued communication with the hot steam chest fluids. Figure 6 shows a well test production graph of No. UP-957 through June 2006 with oil and gross fluid rates, water cuts, fluid temperatures and pumping fluid levels over the pump (409 ft difference between pump and mid-perforation depth).



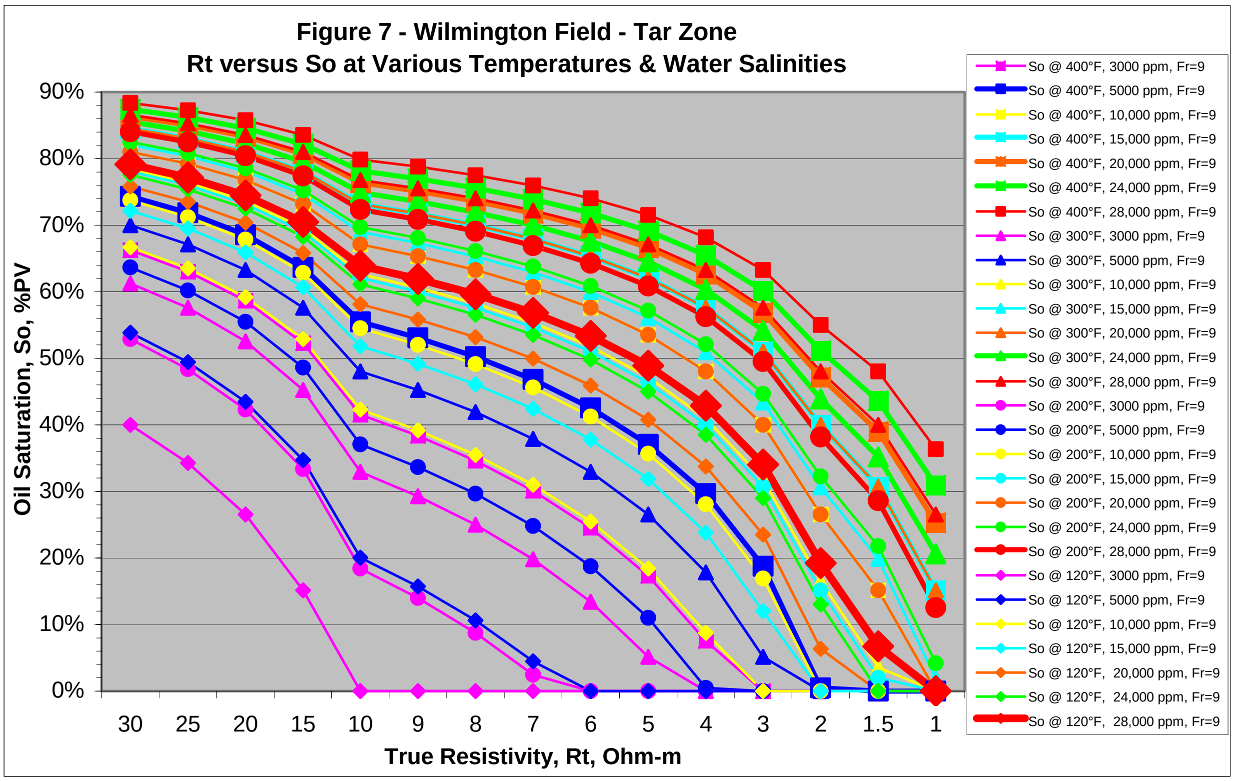
If well UP-957 is connected to the steam chest, this flow path undoubtedly will dominate future productivity from the well, as it is hotter and has much higher mobility than the cooler and more viscous tar sands across the completion interval, especially if producing fluid levels remain high. On the other hand, the well has produced within 10% of the base case projected oil rate and cumulative oil volume after two years, paid out the drilling and completion costs within a year, and is highly profitable. Cumulative oil production through May 2006 is 58,406 bbl. or 35% of the projected well reserves.

The study area provided a unique opportunity to examine the effect of sustained heating on the formation petrophysical properties. For conventional material balance studies, resistivity logs are used at Wilmington to assess remaining oil saturations. For the majority of the tar zone oil sands, a minimum of 6.0 Ohms of true resistivity is used as the completion cutoff point for economically recoverable steamflood oil. A true resistivity of 6.0 Ohms in the tar zone sands at the pre-steamflood temperature of 120 degrees and formation water salinity of 28,000 ppm yields an estimated oil saturation of 53 percent pore volume.

The logging-while-drilling resistivity log for well UP-957 showed extremely low true resistivity values in the steam chest area, ranging from below 1.0 Ohm where the well first entered the D1 sands in the main steamflood area, to 2.0 Ohms from the Ford Fault to 60 feet before the casing point. These low resistivities resulted in oil saturations of 0-19 percent using pre-steamflood formation temperatures and water salinities. The resistivity readings were so low in the steam chest area that some were below the typical tar zone readings for 100 percent formation water saturation.

The low-resistivity readings were believed to be a tool problem, so a second conventional open-hole resistivity logging tool was run on the end of drill pipe, which confirmed the low readings. Resistivity-based oil saturations were reevaluated for in-situ formation temperatures and water salinities. A map of the average formation temperatures in the top third of the D1 sands in the steamflood area showed formation temperatures in the neighborhood of 400 degrees along the well path based on the reservoir simulation model in July 2003. Monthly analyses of produced fluids from multiple Tar II-A wells have shown increasing salinities during the post-steamflood phase from 3,000 to 28,000 ppm. Salinities in the well path area currently range between 20,000 and 24,000 ppm.

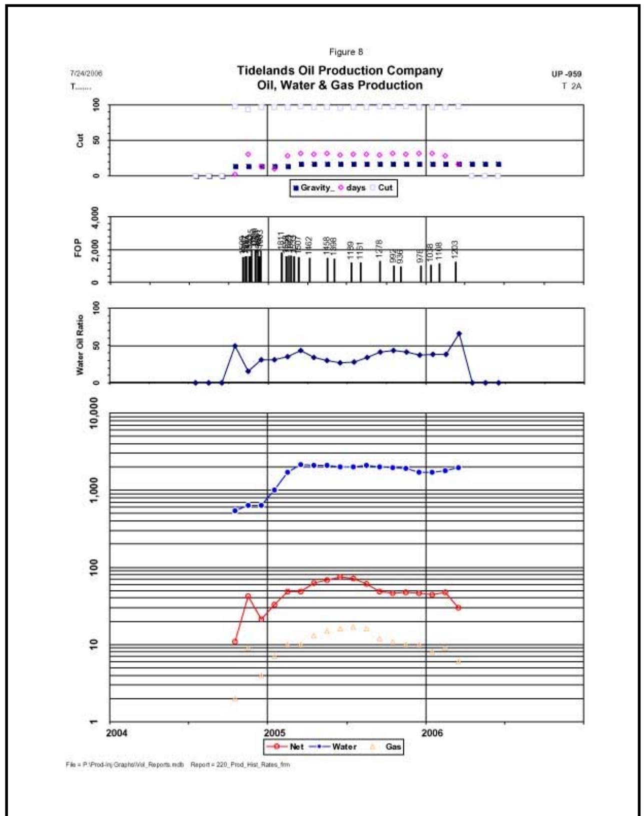
Figure 7 is a chart of oil saturations versus true resistivities assuming reservoir temperatures of 120-400 degrees and formation water salinities of 3,000-28,000 ppm. As shown, resistivities of 1.0-2.0 Ohms at 400 degrees and formation water salinity of 24,000 ppm signify oil saturations of 31-51 percent. This oil saturation range closely aligns with the remaining oil saturations estimated by the model in the steam chest area shown in Figure 4.



ACTIVITY 1.3
RESERVOIR MANAGEMENT

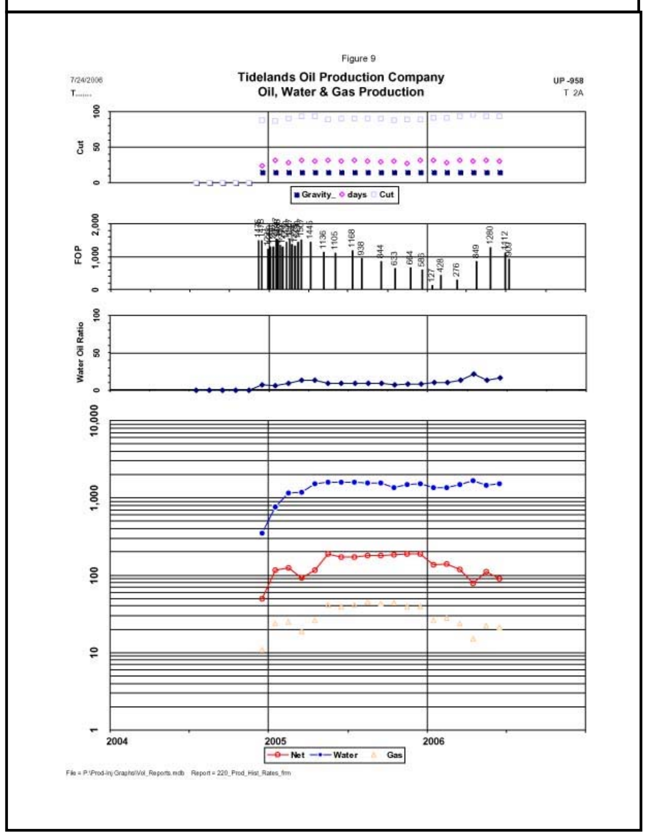
Tar II-A Infill Delineation Production Well UP-959

Well UP-959 was drilled as a directional delineation well. The well was drilled in an structurally updip position that provided a current vertical oil saturation profile showing significant oil depletion in the former steam chest area ranging from 20-75% recovery of the original oil in place, averaging about 50% oil recovery. Most of the remaining oil was in the T2, the D1b&d, and top of the D1 sands. UP-959 was selectively perforated into the top of the D1 sands and completed with an inner wire-wrapped screen and gravel-packed. The well was placed on production in October 2004 at 42 BOPD and 737 BPD gross fluid and peaked at 84 BOPD and 2108 BPD gross fluid in June 2005. Production declined to 55 BOPD and 1840 BPD gross fluid by February 2006 and the well watered out in March 2006. Most likely, the high gross fluid rates coned water into the well. The plan is to leave the well idle for a few months and then activate it at a much lower gross fluid rate. Figure 8 is a production graph for UP-959 through June 2006.



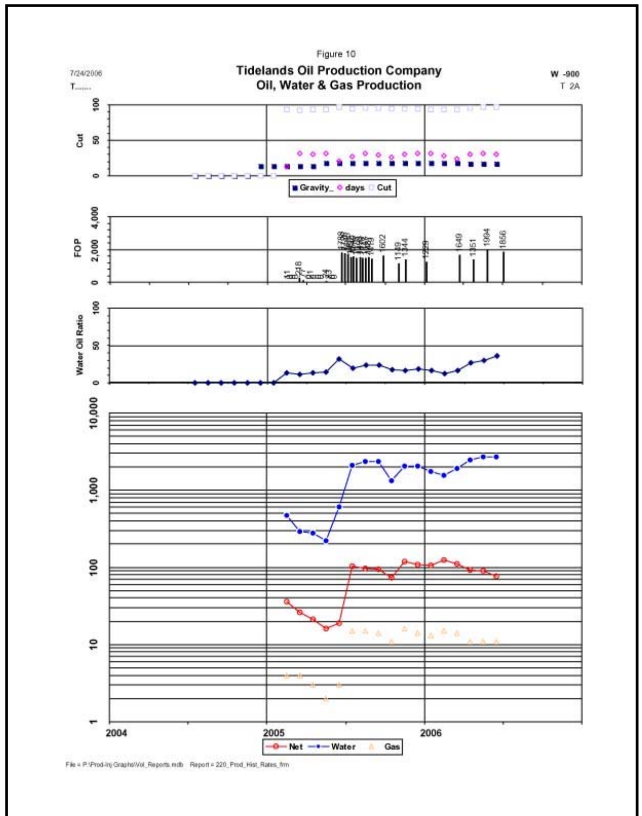
Tar II-A Horizontal T2 Sand Production Well UP-958

This well was drilled and completed along the top of the T2 sands in the updip steamflood area, and like wells UP-957 and UP-959, showed low apparent oil saturations in the open-hole logs. The well was drilled based on the Tar II-A 3D thermal reservoir simulation model to capture oil that gravitated updip, despite the expected instantaneous low oil saturation data shown on well logs. The well was completed with 1067 ft of open-hole, 4.5” wire-wrapped, gravel-packed completion. The well was placed on production in December 2004 and has been excellent, peaking at 219 BOPD and 1828 BPD gross fluid five months after initial start-up compared to the projected initial oil rate of 140 BOPD. Production in June 2006 was still high at 97 BOPD and 1696 BPD gross fluid. Figure 9 is a production graph of UP-958 through June 2006.



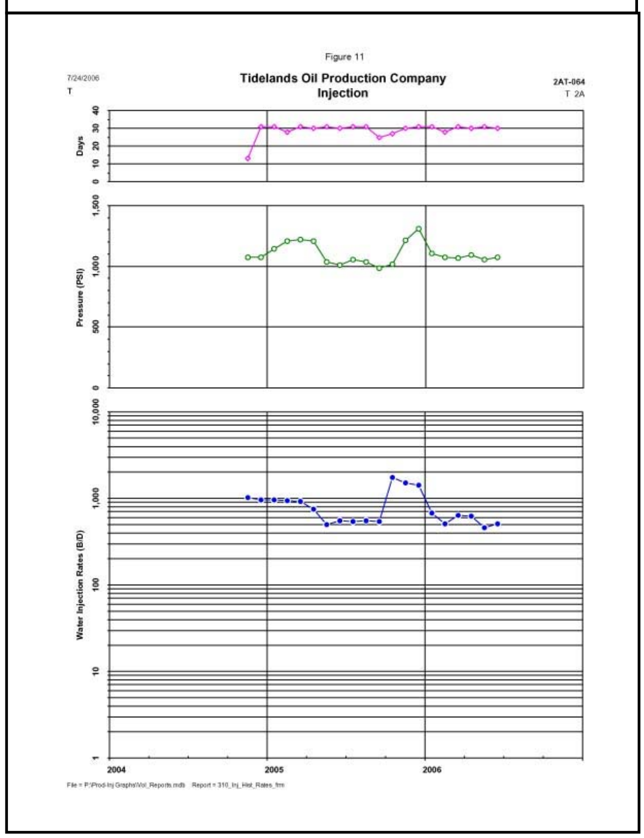
Tar II-A Horizontal D1 Sand Production Well W-900

This well was drilled to penetrate and complete all of the D1 sands over a long measured depth interval exceeding 1500 ft. The well was initially completed in February 2005 in the lower D1 sands (D1b and D1d) with selected perforations and an inner wire-wrapped screen and gravel-pack to test oil productivity. The well produced at low oil and gross fluid rates of 48 BOPD and 532 BPD gross that were relatively cool, about 140-180°F. Production declined to 26 BOPD and 205 BPD gross by June 2005, when the well was recompleted and commingled with perforations at the top of D1 sands. The well production peaked at 177 BOPD and 2461 BPD gross fluid in July 2005 and declined to 78 BOPD and 2794 BPD gross fluid by May 2006. Figure 10 is a production graph of W-900 through June 2006.



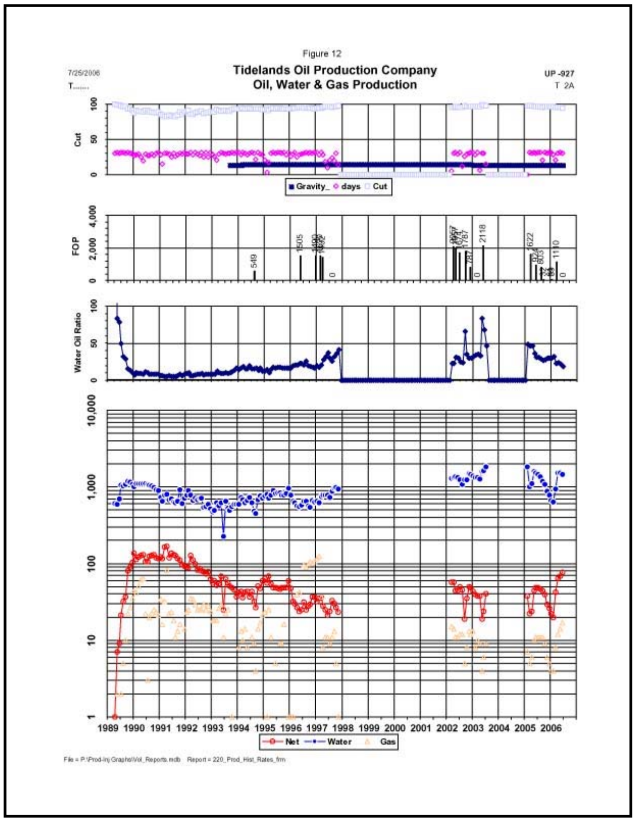
Tar IIA T Sand Injection Well 2AT-64

This well was drilled in a structurally downdip location to replace T sand injection well 2AT-62, which was abandoned for the POLB. The well logs showed high remaining oil saturations in the D1 sands in a downdip structural position in the reservoir that was obviously bypassed during the waterflood development phase of Tar II-A during the 1960s and 70s. The well was activated in November 2004 and initially injected 1242 BWIPD, which quickly declined to a stabilized rate of 500 BWIPD at 1040 psi maximum wellhead pressure. In October 2005, the well had an inner wire-wrapped screen and gravel-pack installed to control sand inflow and was given a HCl-HF acid stimulation job. The well injection rate rose to 2054 BWIPD but by January 2006 had declined back down to 800



BWIPD. Well injectivity was significantly lower than the 2500 BPD anticipated rate, probably due to highly saturated cold oil surrounding the wellbore, which reduces the water relative permeability. The project team is evaluating new chemicals and procedures to test on this well to improve injectivity. Figure 11 is an injection graph of well 2AT-64 through June 2006.

Replacement wells UP-959 UP-958, and W-900 peaked at 84 BOPD, 219 BOPD and 177 BOPD, respectively, for a total of 480 BOPD compared to the 345 BOPD produced by the wells that were abandoned. Wells W-900 and UP-958 confirm that oil resaturation can be accelerated into the steam chest area as indicated by the model. However, UP-959 watered out and the two horizontal wells produced only 175 BOPD in June 2006 so losing the original wells due to the POLB construction work hurt the project.



April 2004 to March 2005 Well Work

Well UP-927 was repaired in February 2005 by installing an inner wire-wrapped screen and gravel pack to restore sand control. This was the only major well workover in Tar II-A from April 2004 to March 2005. The job was successful, resulting in near-term peak production of 58 BOPD and 1496 BPD gross fluid in July 2005. Production following a pump change and HCl acid stimulation job in March 2006 increased to a peak of 85 BOPD and 1566 BPD gross fluid in June 2006. Gross and net oil production rates have decreased to 54 BOPD and 856 BPD gross fluid in July 2006, most likely because of pressure communication and interference with new offset well UP-960. Although net oil and gross fluid rates are lower, water cuts have improved slightly to 94% from 95%. Figure 12 is a production graph of UP-927 through June 2006.

Five Tar IIA wells were plugged and abandoned April 2004 to March 2005:

1. <u>Tar IIA T and D1 sand production well UP-939:</u> Well abandoned for POLB in March
2. <u>Tar IIA T and D1 sand production well UP-941:</u> Well abandoned for POLB in March
3. <u>Tar IIA T and D1 sand production well UP-942:</u> Well abandoned for POLB in March
4. <u>Tar IIA T and D1 sand production well UP-950:</u> Well abandoned for POLB in March
5. <u>Tar IIA T sand injection well 2AT-62:</u> Well abandoned for POLB in January

April 2005 to March 2006 General Work

During the current reporting period from April 2005 to March 2006, oil production declined in March 2005 from the abandonment of producing wells UP-939, UP-941, UP-942 and UP-950 and dropped to as low as 967 BOPD in April 2005. Oil production rose to a high of 1422 BOPD in November 2005 from converting or repairing existing wells and drilling new wells. Several idle wells were activated in May 2005 to increase production and water injection. Wells AT-42, AT-43 and AT-63 were converted from steam injection to production and wells 2AT-21, 2AT-22 and 2AT-23 were converted from steam to water injection. New horizontal well W-900 was recompleted in June 2005 to the top of the D1 sands in the “depleted steam chest section” and peaked at 177 BOPD in July 2005. Existing producers UP-923 and UP-930 were given workovers from June to July 2005 to improve oil production. Oil production from T sand horizontal well UP-958 steadily improved from an initial rate of 35 BOPD and 245 BPD gross fluid in December 2004 to a peak rate of 219 BOPD in September 2005. New well UP-961 was activated in November 2005 with an initial peak rate of 185 BOPD and new well UP-960 was activated in January 2006 and reached a peak oil rate of 70 BOPD in March 2006. New well UP-957 was watering out and had a tubing sleeve installed in March 2006 that resulted in 65 BOPD. Wells 901-UP, 2AT-24 and 2AT-35 were worked on to convert or activate them for water injection at year-end 2005 to early 2006.

Tar II-A production from April 2005 to March 2006 averaged 1192 BOPD, 34,846 BPD gross fluid, water-oil ratio (WOR) of 23.97 and 44,346 BPD water injection compared to production and injection rates the previous year of 1169 BOPD, 29,185 BPD gross fluid, WOR of 28.22 and 41,431 BPD water injection. Activation and/or conversion of idle wells to production and injection has continued to result in more incremental water production and associated water injection with only a short-term increase in oil rates. Existing producers, especially those closest to the water injectors, are experiencing higher water cuts or watering out from the increased injection water.

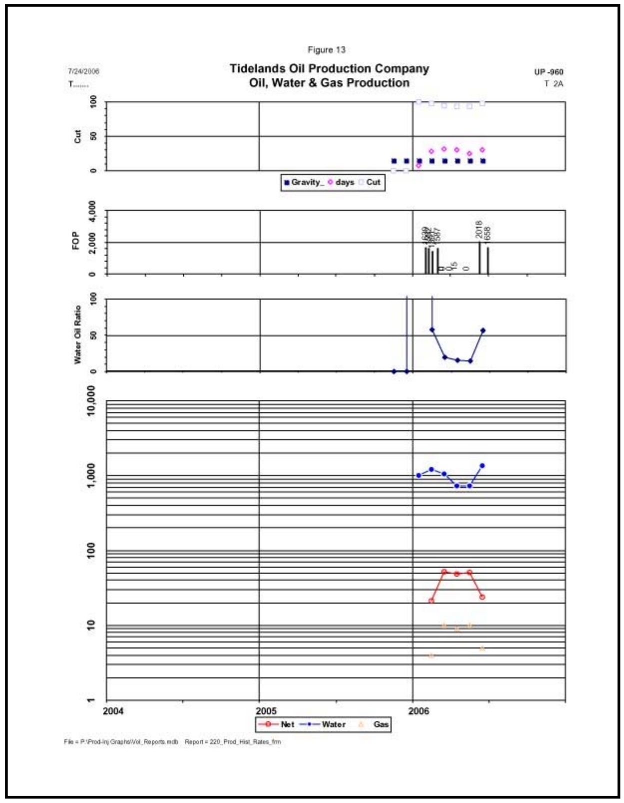
Development Drilling during the Last Half 2005

Three new wells, UP-959, UP-958 and W-900, that were proposed in the DOE BP2 plan for the Tar II-A project, were drilled at the cost of the POLB as compensation for abandoning other wells. Two of the budgeted wells were replaced by new Tar II-A wells UP-960 and UP-961, which were drilled during the second half 2005.

Tar II-A Infill Delineation Production Well UP-960

Well UP-960 was drilled in November 2005 for the DOE project as a vertical infill delineation well in place of well UP-959. The objectives were to determine remaining oil saturations in a mid-structural pattern location within the main steamflood area that had experienced both steamflooding and hot waterflooding and to find out why adjacent wells have abnormally high water cuts. The well logs showed good oil saturations in the T sands at pre-waterflood levels, even though waterflood and steamflood injectors surround the well, whereas the D1 sands appear oil depleted by steamflooding. The T sands do not appear resaturated because a recent temperature survey run in the well shows the sands as relatively cold from 140-180°F, as if they were never steamed.

These patterns were steamflooded for 6-7 years and then hot waterflooded for two years; therefore, it is difficult to understand why the sands are not hot just from conductive heat transfer. The resistivity log looks just like an offset 1953 well that was completed in a deeper zone. The D1 and D3 sands were very hot and exhibited the same characteristics as in well UP-959, only the resistivities were even lower. Based on the So versus Rt chart[1] developed for UP-957 (Figure 7) and assuming reservoir temperature of 300°F and 20,000 ppm salinity, the D1 sands (0.7 - 2.0 ohms) had less than 15% So at the top and 40% So at the middle to bottom of the sands.



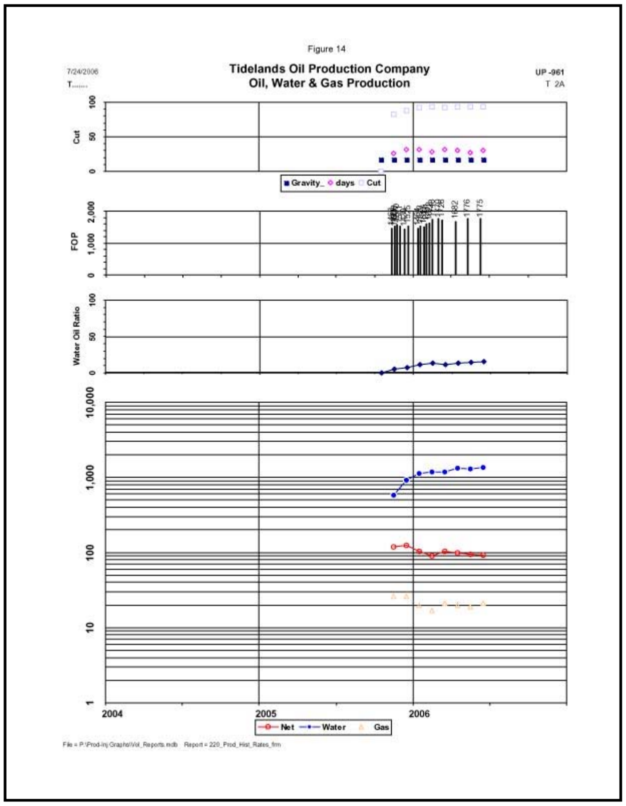
The well was cased to total depth and completed in the T sands and the top of the D1 sands, assuming that the remaining D1 oil will migrate and resaturate the top of the sands. An inner wire-wrapped screen was gravel-packed inside the casing for sand control. Completing the depleted former steam chest sands followed the same philosophy used to complete successful horizontal wells UP-957, UP-958 and W-900. Well UP-960 was activated on January 23, 2006 with an initial rate of 1 BOPD and 1001 BPD gross fluid. The well was sped up and by February 14 it was producing 18 BOPD and 1462 BPD gross fluid (98.8%water cut). The well peaked on February 20 at 70 BOPD and 1328 BPD gross fluid (94.7% water cut). The fluid level was pumped down to the pump and the pumping unit was slowed, which resulted in the well producing 52 BOPD and 783 BPD gross fluid (93.4% water cut) on April 19, which is a good rate for an infill well location. The well was given an HCl/HF acid stimulation job in May and production restarted in June 2006 at 1 BOPD and 1285 BPD gross fluid. The well was sped up and the latest well test on July 13 was 45 BOPD and 1759 BPD gross fluid (97.4% water cut). The acid job appeared to connect with thief sands containing mobile waters and in hindsight, should not have been done. The well may be in communication with offset well UP-927 as oil and gross fluid rates and fluid levels appear to be changing similarly. Figure 13 is a production graph of UP-960 through June 2006.

Tar IIA Horizontal D1 Sand Production Well UP-961

Well UP-961 was drilled for the DOE project in place of well W-900 as a horizontal D1 sand well, only instead of drilling into the updip depleted steam chest, the well was completed in the downdip cold tar sands in a highly oil saturated area where vertical wells produced at 98+% water cuts. This well will capture downdip, cold, heavy oil reserves at the top of the D1 sands that were left behind during the Tar II-A waterflood period from 1959-1981.

The 3-D reservoir simulation model showed that continued operations through the year 2013 would not recover oil from the highly oil saturated D1 sands in the cold, structurally downdip areas south of the steamflood patterns. Recent drilling of replacement Tar II-A downdip water injection well 2AT-64 and new Upper and Lower Terminal zone injection well 2AU-512 in this area confirmed the very high oil saturations greater than 70% PV at the top of the D1 sands. When UPRC developed their Tar II-A waterflood in 1959, they avoided this area because initial vertical waterflood wells had 98-99% water cuts and they concentrated their efforts in the structurally updip sands. New horizontal well UP-961 was drilled in November 2005 outside the steamflood area along a downdip structure contour along the top of the cold D1 sands, a very counter-intuitive decision based on past well performance. The well had 7-5/8" casing and was completed in the open hole with 993 ft of 4-1/2" wire-wrapped screen and a gravel-pack for sand control.

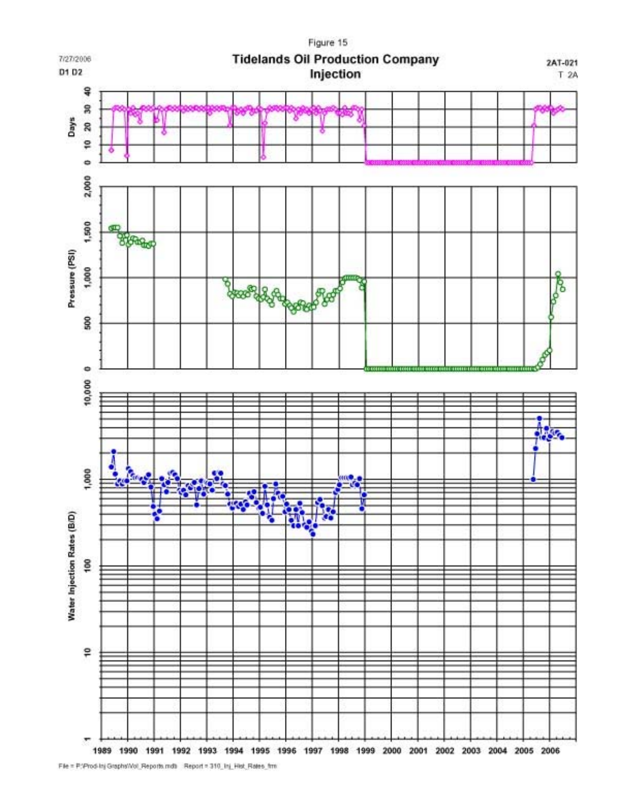
The logs for well UP-961 confirmed the high oil saturations and the well was placed on production on November 4, 2005 with an initial peak rate of 185 BOPD and 635 BPD gross fluid (70.9% water cut). The well had high fluid levels ranging from 1400-1700 feet over the pump and was sped up. Oil production declined but still tested 115 BOPD and 1285 BPD gross fluid (91.1% water cut) in January 2006. Through June 2006, the well has stabilized production of 97 BOPD and 1437 BPD gross fluid (93.2% water cut). Figure 14 is a production graph of UP-961 through June 2006.



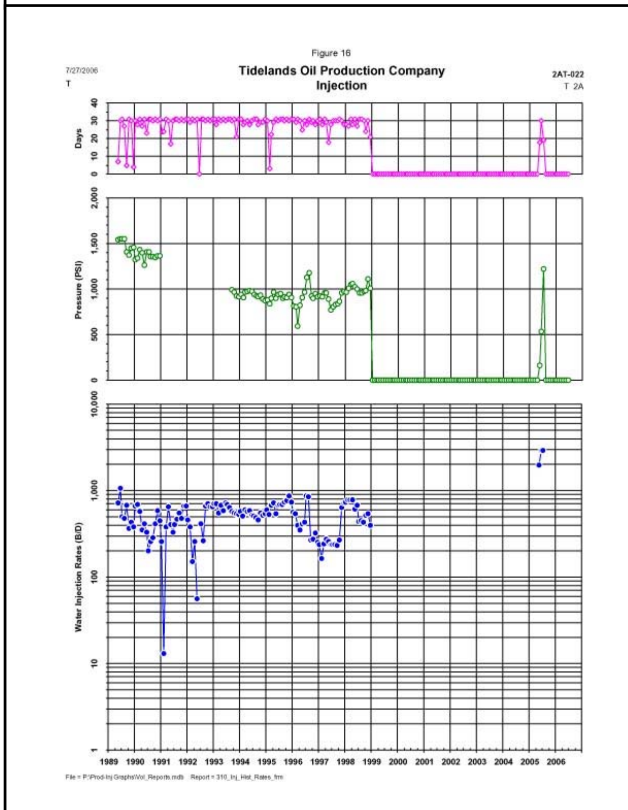
Well Work April 2005 to March 2006

Eleven idle wells were worked on to activate and/or convert for use as Tar II-A producers (wells AT-43, AT-42, AT-63, UP-923, UP-930) or water injectors (2AT-21, 2AT-22, 2AT-23, 2AT-35, 2AT-24, 901-UP) from April 2005 to March 2006. All of the wells except UP-930 are completed in a single sub-zone, T or D1 sands, to provide better reservoir management control in an effort to increase oil production rates and reduce water cuts.

Six of the jobs were listed in the DOE BP2 proposal and the work on well UP-923 replaced a similar job slated for Tar V well A-194 that was completed prior to BP2 approval. The work on wells UP-930, 2AT-35, 2AT-24, and 901-UP were not included in the BP2 budget. The five producers peaked at 242 BOPD and 6009 BGFPD (96.0% water cut), with three wells being good and two wells producing almost all water. Two of the three other wells subsequently watered out and require further review. Five of six wells were converted successfully to water injection, while one well had casing damage.



<u>1. Tar II-A D1 sand well 2AT-21 (DOE BP2):</u> Successfully converted steam injection well to water injection in May 2005 at 1000 BPD. Injection was quickly increased to 3000-5000 BPD and the well has injected up to 7000 BPD on occasion. Figure 15 is an injection graph of 2AT-21 through June 2006.

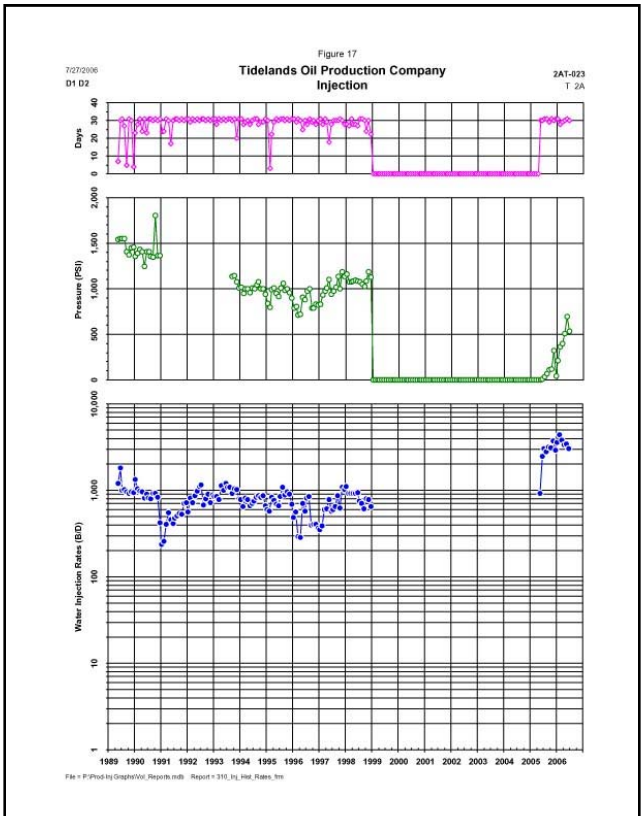


<u>2. Tar II-A T sand well 2AT-22 (DOE BP2):</u> Successfully converted steam injection well to water injection at 2000-3000 BPD from May to July 2005. The well experienced a packer leak and upon investigation, a severe shallow casing restriction was found at 1600 ft. A packer fish and tubing kill string were left in hole and the well was idled. Figure 16 is an injection graph of 2AT-22 through June 2006.

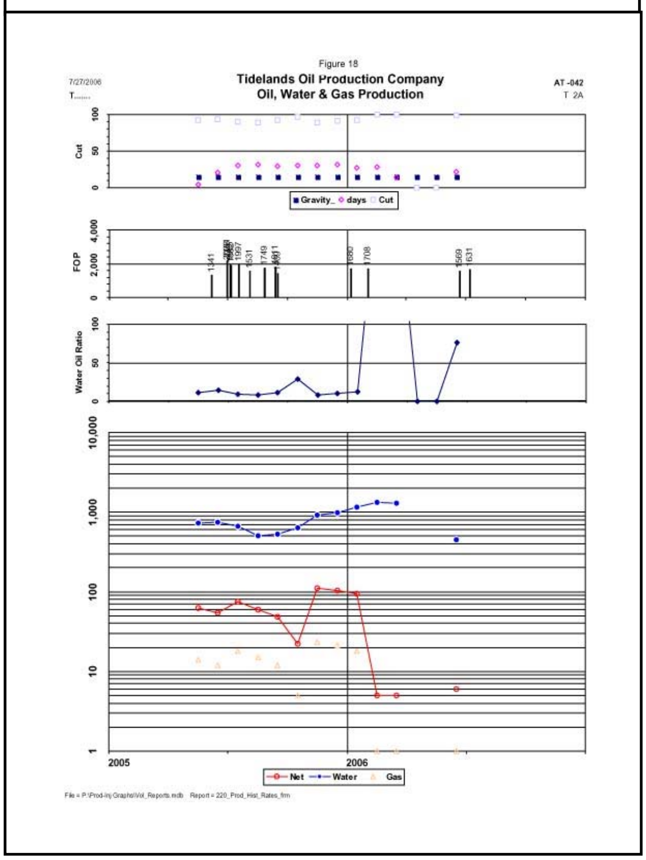
<u>3. Tar II-A D1 sand well 2AT-23 (DOE BP2):</u> Successfully converted steam injection well to water injection in May 2005 at 1000 BPD. Injection was quickly increased to 2500-5000 BPD and on occasion the well has injected up to 7000 BPD. Figure 17 is an injection graph of 2AT-23 through June 2006.

<u>4. Tar II-A T sand well 2AT-42 (DOE BP2):</u> Successfully converted to

production as well AT-42 in May 2005 at 75 BOPD and 792 BPD gross fluid. Production fluctuated from 60-130 BOPD and 900-1200 BPD gross fluid from June to December 2005. In January 2006, the well watered out and the produced fluids were very hot and the pump would gas lock. The well was temporarily plugged back to the top of the T2 sands in June 2006 and activated at a much lover rate of 2-4 BOPD and 334-430 BPD gross fluid and pumping fluid level of 1631 ft over the pump. The next test will be to increase gross fluid production to 600-700 BPD to see if oil cuts improve. Figure 18 is a production graph of AT-42 through June 2006.

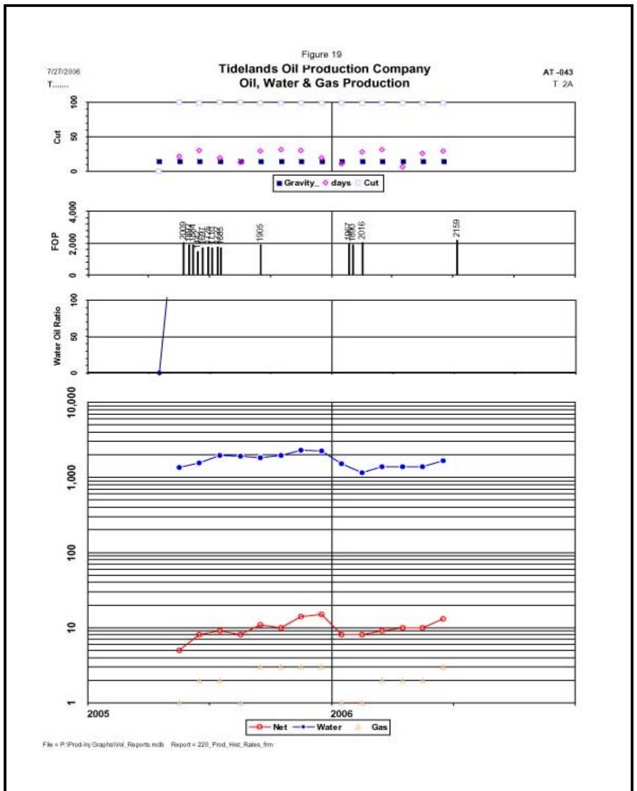


<u>5. Tar II-A D1 sand well 2AT-43 (DOE BP2):</u> Converted to production as well AT-43 in May 2005 with very high water cuts to date. Production peaked at 20 BOPD and 2334 BPD gross fluid in December 2005. The well was plugged back with sand to the upper D1 sands and production in 2006 has ranged between 8-20 BOPD and 900-1425 BPD gross fluid, the higher rates coming after a pump speed up in June 2006. The well will continue to be produced to see if the high rates induce oil to migrate upwards to the well. Figure 19 is a production graph of AT-43 through June 2006.

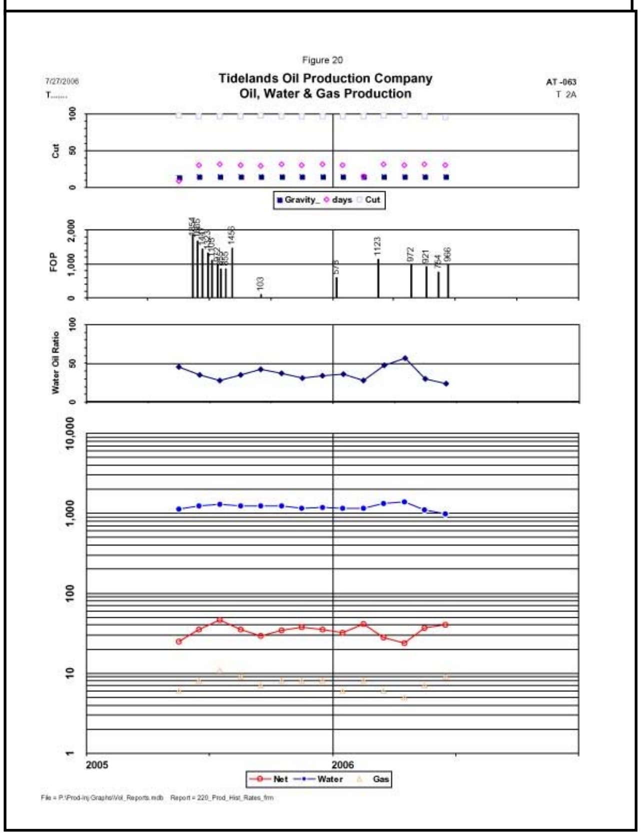


<u>6. Tar II-A horizontal D1 sand well 2AT-63 (DOE BP2):</u> Successfully converted pilot horizontal steam injection well to production as well AT-63 in May 2005. Peak production occurred in June 2005 at 54 BOPD and 1375 BPD gross fluid with a pumping fluid level of 1447 ft over the pump. Oil and gross fluid rates have declined slowly to 42 BOPD and 994 BPD gross fluid with 578 ft fluid level over the pump in June 2006. Figure 20 is a

production graph of AT-63 through June 2006.



7. Tar II-A T sand well UP-923 (DOE BP2 in place of A-194): Successfully repaired well by installing inner wire-wrapped screen and gravel pack to restore sand control in July 2005. The well initially produced 57 BOPD and 440 BPD gross fluid and then experienced three well failures within six months that required pulling jobs. After the first pulling job in October 2005, the well only produced 13 BOPD and 398 BPD gross fluid. After the second pulling job in November 2005, the well resumed good rates of 58 BOPD and 338 BPD gross fluid. After the third pulling job in February 2006, the well only produced 1 BOPD and 379 BPD gross fluid. After confirming the bad production, the well was idled in April. Figure 21 is a production graph of UP-923 through June 2006.



8. Tar II-A T and D sand well UP-930: Successfully repaired well by installing 228 ft. of 5-1/2" blank liner above the 5-1/2" liner top to seal off a casing leak in June 2005. The well is located structurally updip and was expected to produce like new updip vertical well UP-959, which was producing 50-80 BOPD at the time. The well initially peaked at 22 BOPD and 1095 BPD gross fluid, which was very hot at 326°F at the wellhead or about 375°F in the formation. The well had pumping problems related to gas, most likely steam breakout around the downhole pump and from non-condensable gases like CO_2, H_2S and mercaptans that migrate into the updip wells. The well experienced lost circulation problems in the lower D1 and D3 sands that could mean the lower sands were either steam depleted or steam bypassed and low pressure. The latter

situation is probably the case. A gas anchor was installed in August 2005. The well was idled in September 2005 due to the high water cuts. The well may be plugged back to the top of the D1 sands like UP-959 to help eliminate watered out sands. Figure 22 is a production graph of well UP-930 through June 2006.

9. Tar II-A D1 sand well 2AT-35: Attempt to convert steam injection well to water injection failed in December 2005 as well has shallow casing damage at 1618 ft.

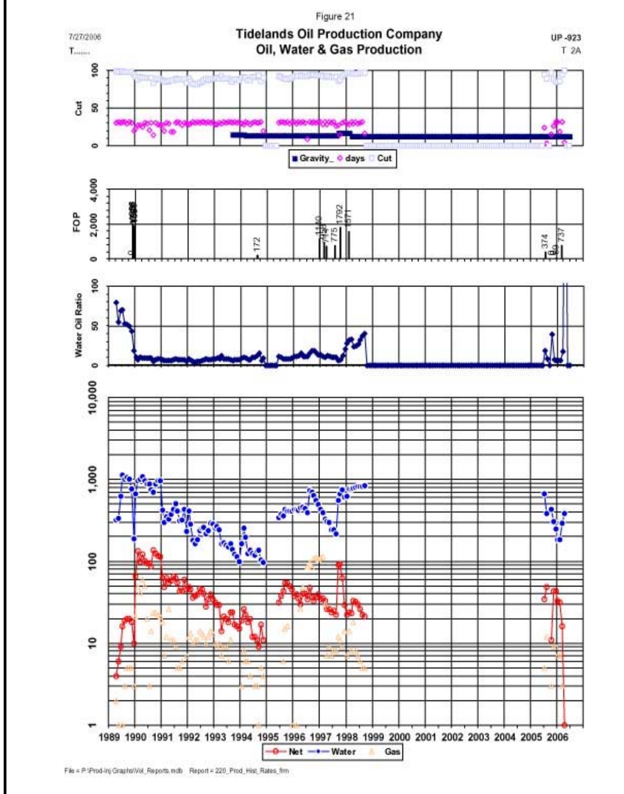
10. Tar II-A T sand well 2AT-24: Successfully converted steam injection well to water injection at 2000 BPD from February to June 2006. Upon surveying the well in June 2006 for water injection profile, a casing hole was discovered at the top of the liner in the S sands and the well was idled. The plan is to repair the well by cementing one joint of blank liner above the existing liner to plug off the casing hole. Figure 23 is an injection graph of 2AT-24 through June 2006.

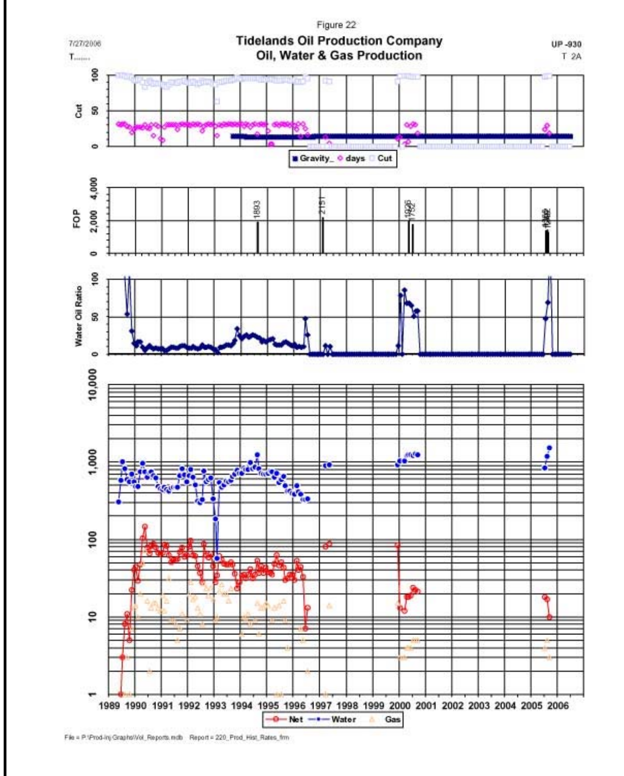
11. Tar II-A T sand well 901-UP: Successfully converted steam injection well to water injection at 2000-3000 BPD in April 2006. Figure 24 is an injection graph of 901-UP through June 2006.

Tar IIA D1 sand injection well 2AT-31 was plugged and abandoned in May 2005 due to irreparable mechanical damage.

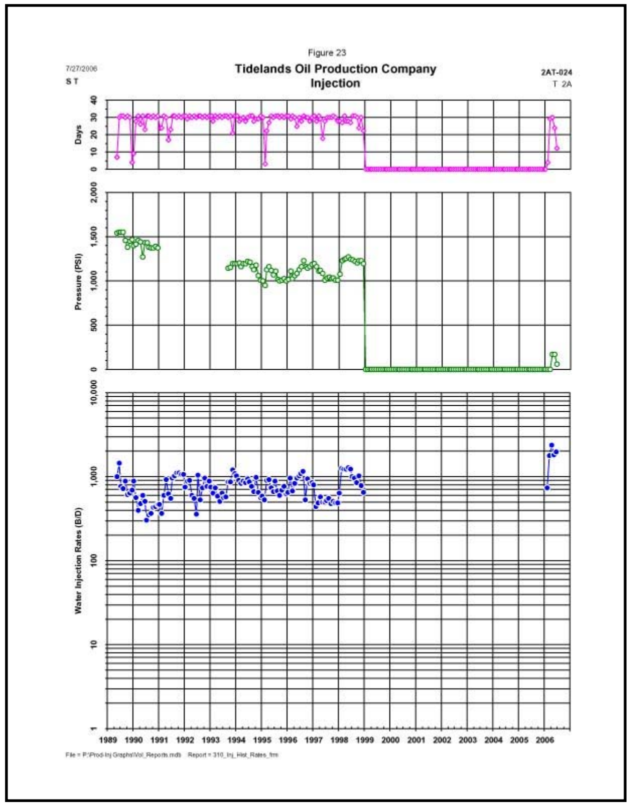
Tar II-A New and Idle Well Conversion and Activation Plan

The Tar II-A post-steamflood project has excellent remaining oil reserve potential that can be recovered by both new and existing idle wells. The 2002 Tar II-A waterflood acceleration

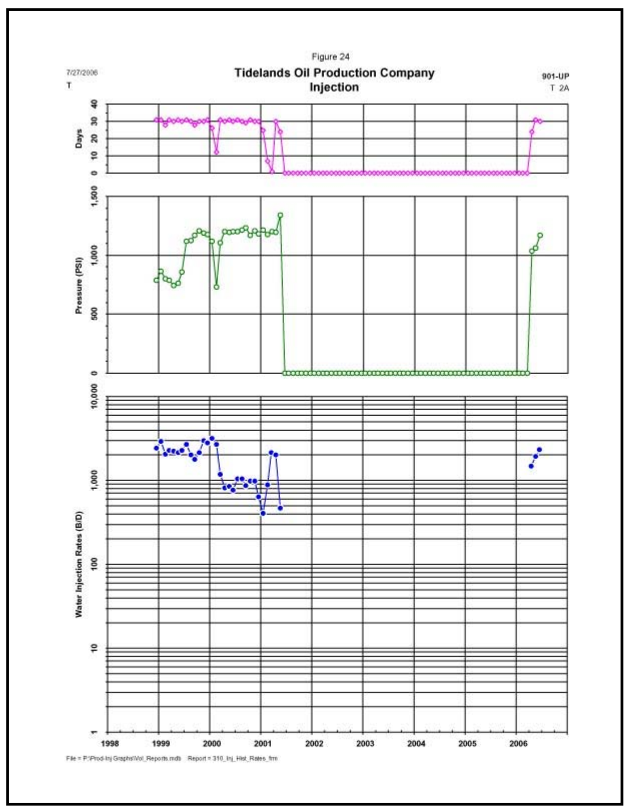




plan, as explained previously, resulted in premature watering out of the producing wells and increased mechanical breakdowns and well costs. The 2002 plan required the flank injection wells to inject water at extremely high individual well rates, which encouraged early water breakthrough, exacerbated poor vertical injection profiles, and created severe injection/production ratio problems when an injection well was idled because of mechanical problems.



Several idle wells can alleviate the production and injection well problems mentioned above at relatively low costs. The objective of this well conversion and activation plan is three-fold: 1) To increase the number of flank injection wells to enable the project to maintain water injection rates while allowing each well to inject water at lower and more maintainable rates. This would also provide spare injection capacity to apply when individual injection wells are idled for well work or other reasons; 2) To improve reservoir control of production and increase oil rates by increasing the number of wells producing from only the T or D sands; and 3) To improve oil production rates by repairing idle producing wells located structurally updip that had previous economic production prior to experiencing mechanical problems. In the near term, the injection wells are also needed to supplement water injection to maintain injection/production (I/P) ratios as idle wells are converted to production.



Increasing the number of flank water injection wells will occur in two stages. The first set of wells converted to water injection this reporting period included former T sand steam injection wells 2AT-22 and 2AT-24 and former D sand steam injection wells 2AT-21 and 2AT-23. An attempt was made to convert D sand steam injection well 2AT-35 to water injection but the well had a severe shallow casing restriction. Well 2AT-22 was idled after two months with similar shallow casing damage and well 2AT-24 was idled when the radioactive tracer survey showed the injected water exiting through a casing hole in the Tar S sands. Also, the first stage included activating T sand water injection well 901-UP. These wells should have provided the needed water injection rates to maintain I/P ratios for the production well conversions. The loss of three injection wells and the unanticipated high gross fluid production rates in late 2005 and 2006 have left the project short of water injection. Although reservoir pressures in the T and D sands appeared stable through September 2005, they began to fluctuate dramatically as new and idle production wells were activated in late 2005 and early 2006.

The second stage will include converting idle producers UP-944 and UP-902 and idle steam injection well 2AT-53 to T sand injection and idle producer UP-854 and steamflood injector 2AT-58 (currently idle producer AT-58) to D sand injection. Also, idle producer UP-905 will be converted to a T and D sand water injector. These wells will allow average water injection rates per well to decline to 2000 BPD rather than the current 3500-4000 BPD rates.

The highest oil production potential wells were believed to be those completed in single subzones, structurally updip, and unaffected by hot waterflooding, including former T sand steam injector 2AT-42 and former D sand steam injection wells 2AT-63 (horizontal well) and 2AT-43. Wells 2AT-42 and 2AT-63 (renamed AT-42 and AT-63) had excellent initial peak rates of 75 BOPD and 54 BOPD, respectively. Well AT-63 has remained a good well but AT-42 watered out, as did well AT-43. New horizontal producers W-900 and UP-958 confirm good oil production potential updip in the former steam chest area, but vertical wells seem to have problems. New well UP-959 and repaired wells UP-923 and UP-930 are all located updip and watered out after a few months of good oil production.

New wells can be drilled strategically to optimize oil rates at lower water cuts, especially horizontal wells and vertical reservoir delineation wells. New horizontal well UP-961 confirmed the oil production potential in the highly oil saturated downdip D1 sands near the heels of the pilot horizontal steamflood wells. Proposed reservoir delineation well UP-960 showed high remaining oil saturations in the T sands despite being located between two patterns that had been steamflooded and hot waterflooded. The well produced at good oil rates until it was acid stimulated. Hopefully oil rates will improve over time. The production performance of these wells and recently drilled updip wells UP-957, UP-958, UP-959 and W-900 will provide the necessary justification for future Tar II-A drilling. Figure 2 is a Tar II-A steamflood pattern map showing the location of the active post-steamflood wells and the proposed wells to be drilled and reactivated.

The Tar II-A post-steamflood project will experience a short-term jump in gross fluid and oil production that will also require increased water injection. The long-term objective is to allow gross fluid rates to decline from its current 40,000 BPD rate to about 27,000 BPD and reduce water injection accordingly to meet 10,000 BPD of net injection. The new and activated producers are capable of producing at much lower water cuts than the existing T and D commingled producers. The goal is to improve overall Tar II-A project oil rates and oil cuts by producing at lower gross fluid rates and injecting significantly less water. A 1.0% oil cut improvement can increase Tar II-A oil rates by 25-30%. This will also reduce the mechanical wear and tear on well equipment and lower the operating and maintenance costs per well.

2006-07 Well Work and Drilling for the Tar II-A Post Steamflood Project

The first objective is to continue realigning the Tar II-A post-steamflood project to increase the wells producing from single subzones and selective completions to improve oil production and reduce water cuts. The second objective is to increase the downdip water injectors to improve the areal sweep efficiency of the waterflood. . The first three proposed jobs shown below are listed in the DOE BP2 plan and the next two jobs are similar to listed jobs and should meet DOE requirements for funding. The sixth job is a temporary test in a new horizontal well that was not planned for BP2.

1. Tar II-A proposed D sand horizontal well UP-962: Drill and complete structurally downdip horizontal well along the top of the Tar II-A D1 sands parallel to the structure contours, similar to well UP-961. This well will replace "well UP-958 " in the BP2 budget as actual D sand horizontal well W-900 was paid for by the POLB.

2. Tar IIA D1 sand production well AT-58: Convert to D sand water injection as well 2AT-58 to improve water injection sweep efficiency of post-steamflood project. This well will replace "well OB2-3" in the BP2 budget as that job was paid for by the POLB.

3. Tar IIA sand production well UP-905: Convert to T and D sand injection well 905-UP to improve water injection sweep efficiency of post-steamflood project.

4. Tar II-A T sand injection well 2AT-24: Repair casing hole by cementing blank liner joint above liner top.

5. Tar IIA D sand steam injection well 2AT-53: Plug back, recomplete and convert to T sand water injection.

6. Tar IIA D sand production well UP-854: Convert to D sand water injection.

7. Tar IIA production well UP-944: Plug back, recomplete and convert to T sand water injection.

8. Tar IIA T sand production well UP-902: Convert to T sand water injection.

9. Tar IIA D1 sand injection well 2AT-55 (DOE BP2): Plug back and recomplete as either a D1 or T sand production well AT-55.

10. Tar IIA T sand injection well 2AT-44: Convert to T sand production well AT-44. This well will replace "well 2AT-35 " in the BP2 budget as that well has casing damage.

11. Tar IIA D1 sand injection well 2AT-54 (DOE BP2): Plug back and recomplete as either a D1 or T sand production well AT-54.

12. Tar II-A T sand water injection well FW-101: Install an inner slotted liner to control sand inflow.

Tar II-A Reservoir Pressures

Maintaining reservoir pressure is important to prevent steam chest reoccurrence and surface subsidence. Since March 2000, reservoir pressures in the "D" sands were maintained at 92±3% hydrostatic through September 2004. The "T" sand pressures were allowed to slowly decline to 87% hydrostatic after reaching a peak pressure of 97% hydrostatic in March 2000. The average reservoir pressures of the T and D sands were slowly reduced from September 2003 to September 2004 as planned by 14 psi and 12 psi, respectively, to 905 psi (87% hydrostatic) and 1010 psi (91% hydrostatic). T and D sand reservoir pressures decreased at a faster rate than planned from September 2004 to March 2005 to 873 psi (84% hydrostatic) and 968 psi (87% hydrostatic), respectively, despite increasing water injection and injection/production ratios to improve reservoir pressure control. Pressures probably declined temporarily because the new updip replacement wells and the original updip wells to be abandoned for the POLB were all produced for a couple of months before the original wells were abandoned in March 2005. Also, well UP-927 had an inner liner installed and was returned to production in February 2005. Other possible reasons for the unusual pressure drops could be the well testers were measuring gross fluid production too low or the water injection metering system was measuring too high.

Reservoir pressures in the T and D sands fluctuated widely from April 2005 to March 2006. The T sands went from 84% hydrostatic pressure in March 2005 to 87% in September 2005, to 73% in December 2005, and up to 82% in March 2006. Reservoir pressure should be about 4% hydrostatic or 40 psi higher. The D sands went from 87% hydrostatic in March 2005 to 89% in September 2005, to 79% in December 2005, and back up to a reasonable level of 89% in March 2006. Table 1 lists the quarterly ending reservoir pressures for the T and D sands from March 1999 to March 2006. The high number of well activations was destabilizing reservoir pressures in specific locations. Fluid level pressure data confirmations occur a month after the fact, making it difficult in the short term to react to specific pressure changes in the reservoir. In February 2006, the City of Long Beach Gas and Oil Department changed the Tar II-A water injection requirements from maintaining reservoir pressures to injecting a net 10,000 BPD of water over gross production. This rate is close to our recent historical net injection average and was done in an effort to better align production and injection on an objective basis. The net injection requirement will be adjusted as necessary to maintain overall control of reservoir pressures.

The T and D sand reservoirs have been acting more like waterfloods where small changes in voidage can result in large pressure drops compared to the gaseous steamflood steam chests that can compress and expand as reservoir voidage or fillup occurs to cushion pressure changes. Now that the steam chests have been collapsed and the reservoirs have been cooled enough to prevent steam chest reoccurrence, the reservoirs can be operated at lower net injection rates and lower injection / production (I/P) ratios of about 1.3 - 1.4, still high compared to the approximately 1.05-1.10 I/P ratios used in most of the other Wilmington waterflood projects. The higher than normal I/P ratios were derived empirically and are needed because of two reasons: 1) the hot produced fluids are less dense than the injection water and therefore take up more reservoir volume per unit weight; and 2) flank water injection losses to the aquifers in the north and south. As the reservoirs cool, the necessity of maintaining high reservoir pressures dwindles. The plan is to get the T and D sand pressures up to 87-89% hydrostatic by the third quarter 2006 and then slowly reduce pressures in both reservoirs to about 85-87% hydrostatic over the next two years and eventually reduce pressures to 70-80% hydrostatic.

TABLE 1
TAR II-A STEAMFLOOD PROJECT - RESERVOIR PRESSURE

"T" Sands - Phase 1-1C Wells	Reservoir Pressure		"D" Sands - Phase 1-1C Wells	Reservoir Pressure	
	psi	hydrostatic %		psi	hydrostatic %
Jun-97	818	79	May-96	594	54
			Aug-98	748	68
Mar-99	887	85	Mar-99	881	79
Jun-99	929	89	Jun-99	1026	92
Sep-99	977	94	Sep-99	1056	95
Dec-99	1002	96	Dec-99	954	86
Mar-00	1008	97	Mar-00	1009	91
Jun-00	1011	97	Jun-00	991	90
Sep-00	1000	96	Sep-00	995	90
Dec-00	1003	96	Dec-00	999	90
Mar-01	992	95	Mar-01	1005	91
Jun-01	956	92	Jun-01	1009	91
Sep-01	928	89	Sep-01	1008	91
Dec-01	922	89	Dec-01	1005	90
Mar-02	915	88	Mar-02	1009	91
Jun-02	910	88	Jun-02	1001	91
Sep-02	941	91	Sep-02	1040	94
Dec-02	929	90	Dec-02	1007	91
Mar-03	918	89	Mar-03	1027	93
Jun-03	895	86	Jun-03	1026	93
Sep-03	920	89	Sep-03	1022	93
Dec-03	915	88	Dec-03	1017	92
Mar-04	915	88	Mar-04	1053	95
Jun-04	917	89	Jun-04	1046	95
Sep-04	906	87	Sep-04	1010	91
Dec-04	886	85	Dec-04	982	89
Mar-05	873	84	Mar-05	968	87
Jun-05	901	87	Jun-05	980	88
Sep-05	902	87	Sep-05	984	89
Dec-05	759	73	Dec-05	880	79
Mar-06	845	82	Mar-06	986	89

Tar V Pilot Post-Steamflood Project
April 2005 – March 2006 General Work

The Tar V post-steamflood pilot project continued to benefit from the successful development drilling of horizontal production wells along the top of the S_4 oil sands. Recently drilled S_4 horizontal wells include A-605 in April 2003, A-604 in May 2004, A-603 in March 2005 and A-115 in October 2005. The four wells had initial peak oil rates of 176 BOPD, 229 BOPD, 412 BOPD and 221 BOPD, respectively, and were producing a total of 373 BOPD of the 444 BOPD produced by the steamflood project wells as of March 2006. Also, pilot steamflood horizontal producer well J-205 was recompleted to the top of the S4 sands in July 2005. Pilot project oil production has increased significantly each reporting year since the one ending March 2003 at 203 BOPD. The

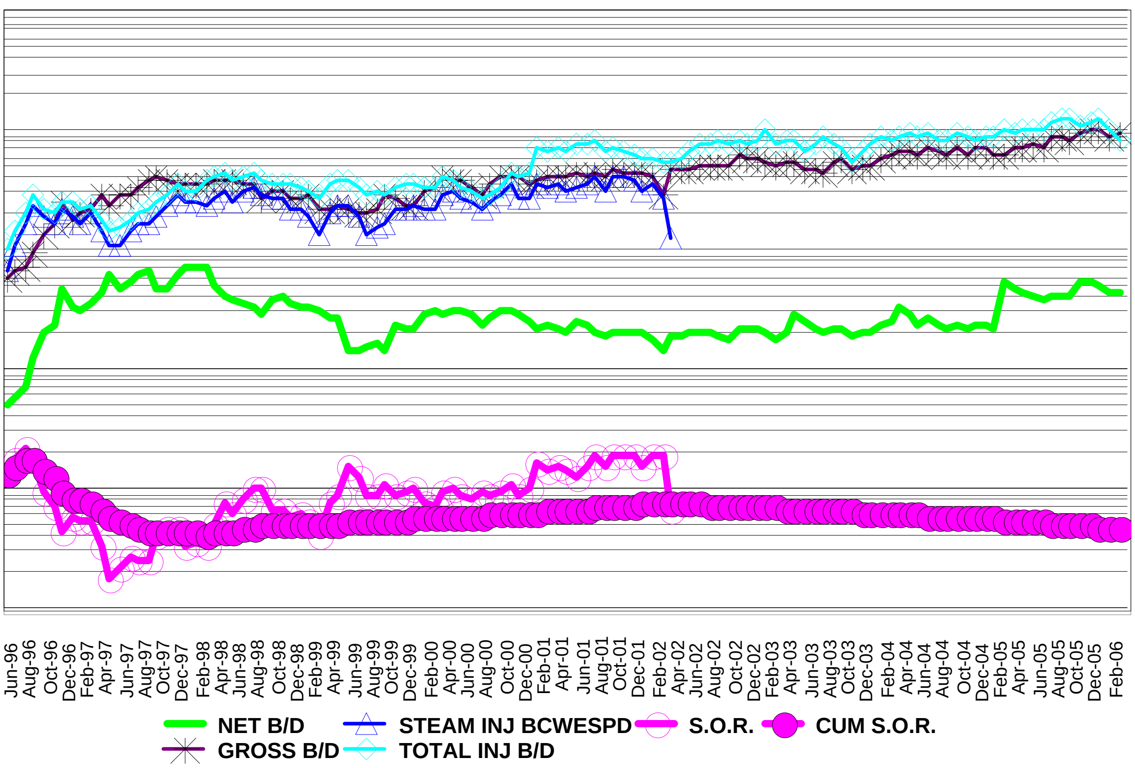


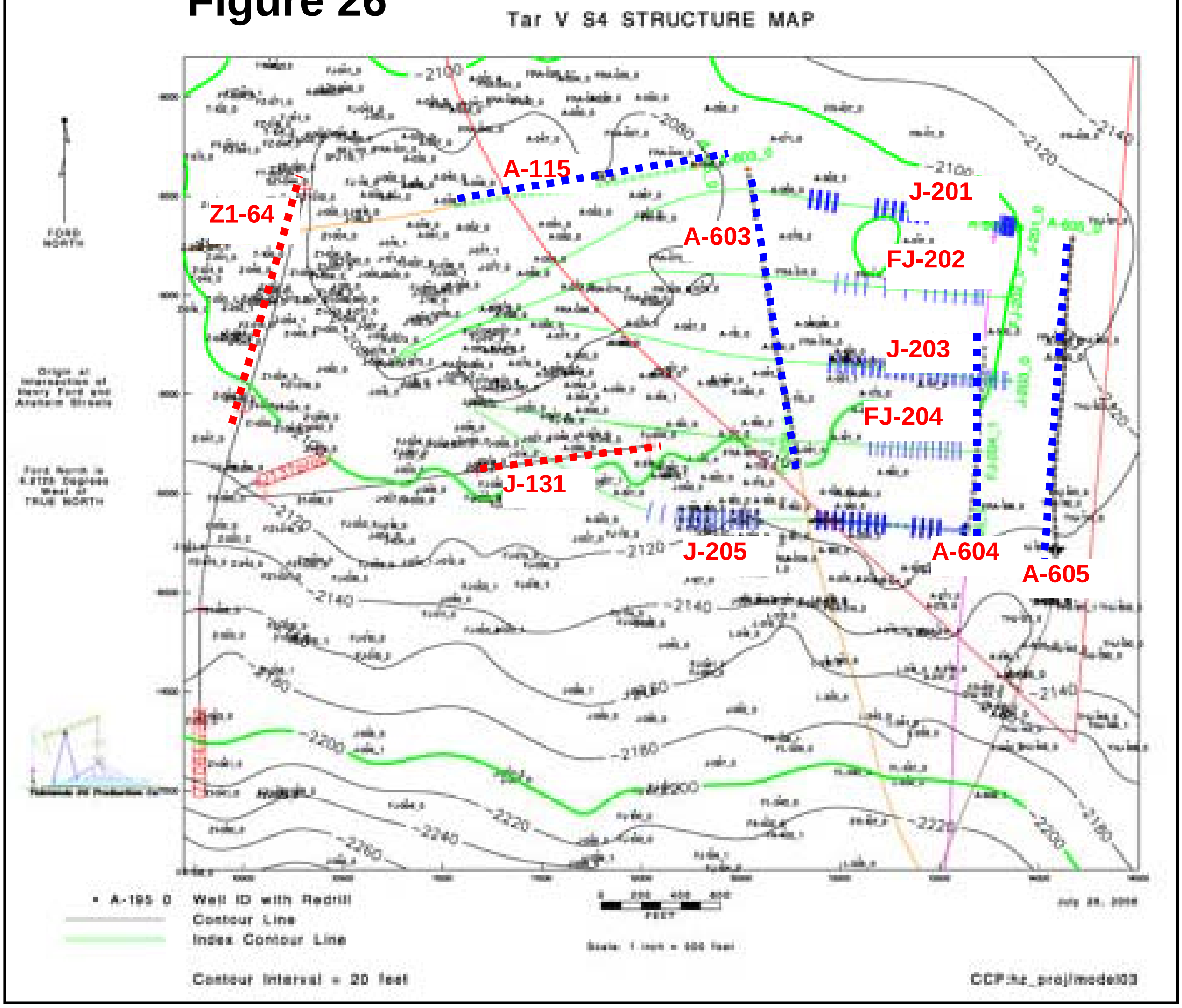
FIGURE 25
TIDELANDS OIL PRODUCTION CO.
TAR ZONE FB-V STEAMFLOOD

average oil production for the year ending March 2004 was 225 BOPD, for the year ending March 2005 was 275 BOPD, and for the latest year ending March 2006 was 464 BOPD. Figure 25 is a production graph of the Tar V pilot steamflood and post-steamflood projects. Figure 26 is a structure contour map of the top of the Tar V S4 sands that shows the location of the post-steamflood pilot wells and the new and proposed cold heavy oil horizontal production wells. The following is a discussion of the new Tar V horizontal S4 sand producer wells drilled since 2003.

Tar V Horizontal S4 Sand Production Well A-605

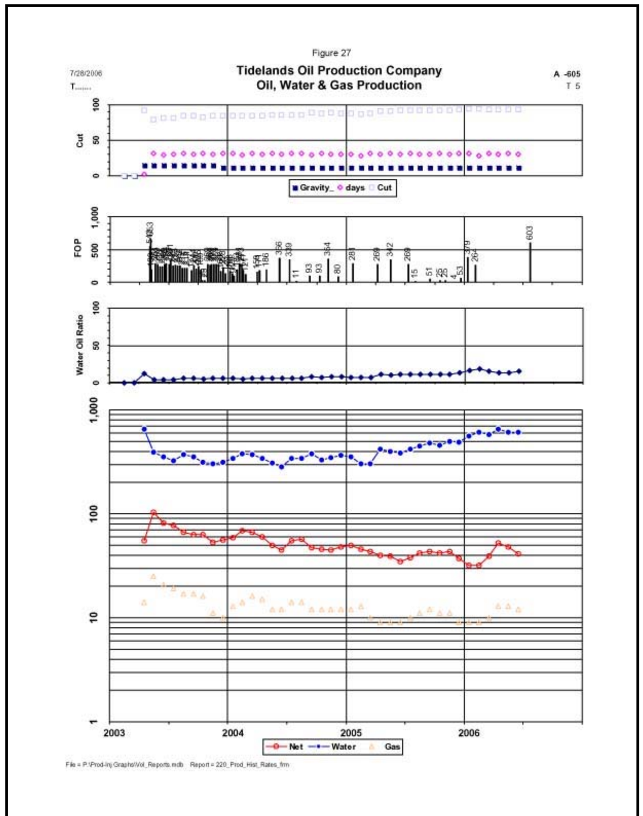
Tar V horizontal well A-605 was drilled and completed running south-to-north along the Thums lease line and perpendicular to the toes of the existing five Tar V horizontal steamflood wells. The well initially produced at a peak rate of 176 BOPD and 560 BPD gross fluid (68.6% water cut) with 543 ft of fluid over the pump in May 2003. Production declined by December 2003 to a stable range of 50-70 BOPD and 350-450 BPD gross fluid for two years and then production declined to about 40-50 BOPD by late 2005. Pumping fluid levels indicated more reservoir pressure in early 2006 and the well began pumping at higher gross rates of 600-800 BPD and oil production rose to 50-60 BOPD. In general, oil production from this well has been stable, cold, and at relatively low water cuts. Although the well was projected to initially produce 120 BOPD and 1500 BGFPD assuming thermal enhanced recovery response, it has been very profitable and easy to operate and was the precursor for the next cold horizontal wells to follow. Figure 27 is a production graph of A-605 from 2003 through June 2006.

Figure 26



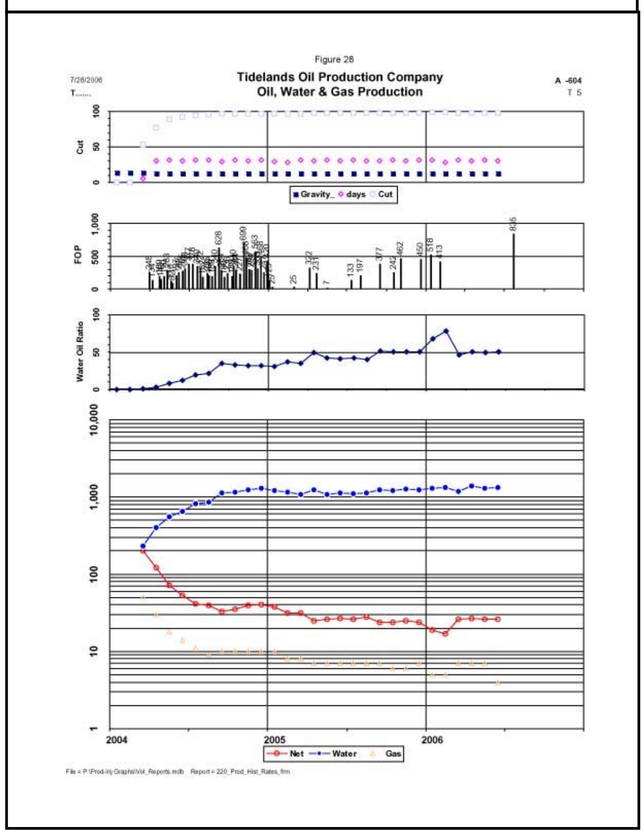
Tar V Horizontal S4 Sand Production Well A-604

Tar V horizontal well A-604 was drilled as a post-steamflood well and sits above the pilot steamflood. The well has coned a high percentage of hot water and has the worst oil production rate and cumulative oil recovery of the four new wells. Well A-604 was drilled in March 2004 with the down-hole location parallel and 400 ft to the west of well A-605 and above the toes of the horizontal steamflood wells. The well was activated in late March at an initial rate of 215 BOPD and 447 barrels of daily gross fluid for a 52% water cut. The oil rate steadily declined to 40 BOPD and 1200 barrels of daily gross fluid by September 2004.. Production stabilized at 31 BOPD by March 2005 and was still at 31 BOPD and 1251 BPD gross fluid in March 2006. Gross fluid production used to average about 135°F, but in the past year fluid temperatures have declined to the normal Tar Zone temperature of 120°F. The well is relatively pumped off and may have formation damage that will require an acid stimulation job. Figure 28 is a production graph of A-604 from 2004 through June 2006.



Tar V Horizontal S4 Sand Production Wells A-603 and A-115

Two new horizontal wells, A-603 and A-115, were drilled in the Tar V post-steamflood pilot project during the past reporting year. The wells were drilled about 800-1600 ft west of A-604 at the top of the S4 sands and outside the steamflood pattern. Both wells produce cold heavy oil and both have open-hole, gravel-packed, wire-wrapped screen completions, similar to wells A-604 and A-605.



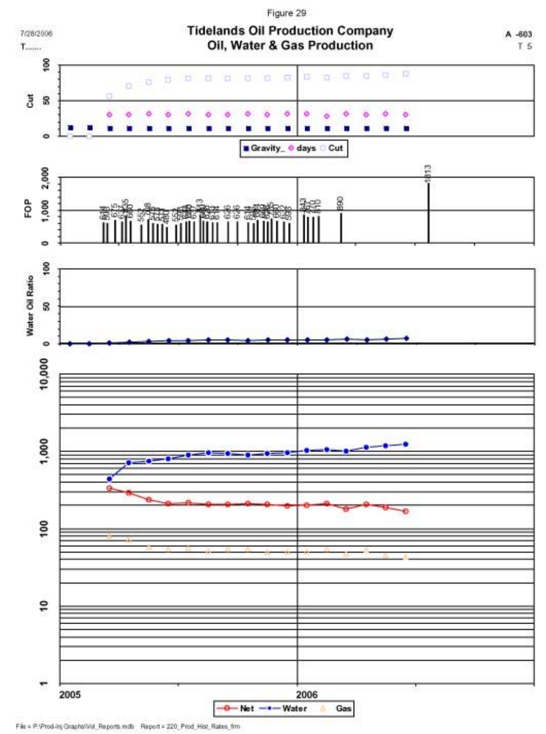
Tar V horizontal well A-603 initially produced at a peak rate of 412 BOPD and 781 BPD gross fluid for a 47.2% water cut in March 2005, and still produced 215 BOPD and 1302 BPD gross fluid in March 2006. This is the best Wilmington Tar zone producing well in at least thirty years. Figure 29 is a production graph of A-603 through June 2006.

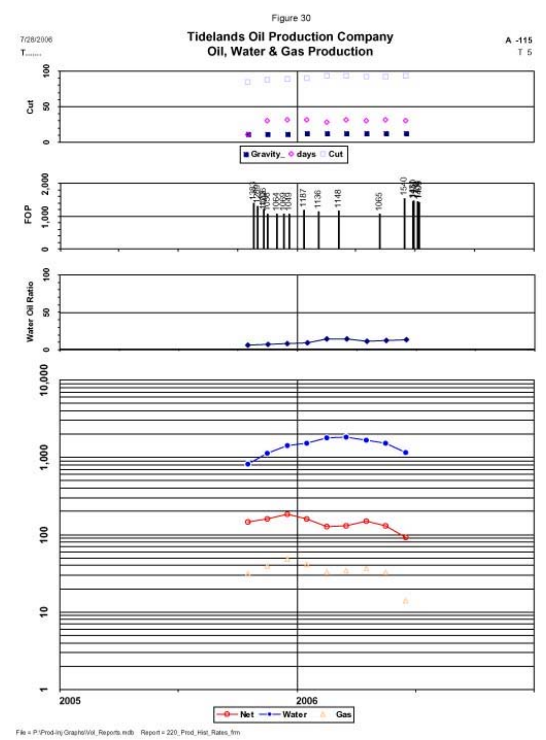
Tar V horizontal well A-115 was drilled to offset highly successful horizontal well A-603 at the top of the S4 sand. The well completion was situated going west to east and perpendicular to A-603 so that the toes of the wells almost meet. The well was drilled in September 2005 and placed on production October 20, 2005 with an initial peak rate of 221 BOPD and 965 BPD gross fluid (77.1% water cut). The oil production declined somewhat and the well was sped up to reach another peak rate of 224 BOPD and 1497 BPD gross fluid (85% water cut) on November 20. The latest test on the well was 138 BOPD and 1868 BPD gross fluid (92.6%) on March 28, 2006, with recent fluid levels ranging from 1050-1200 feet over the pump. Figure 30 is a production graph of A-115 through June 2006.

April 2005 – March 2006 Well Work

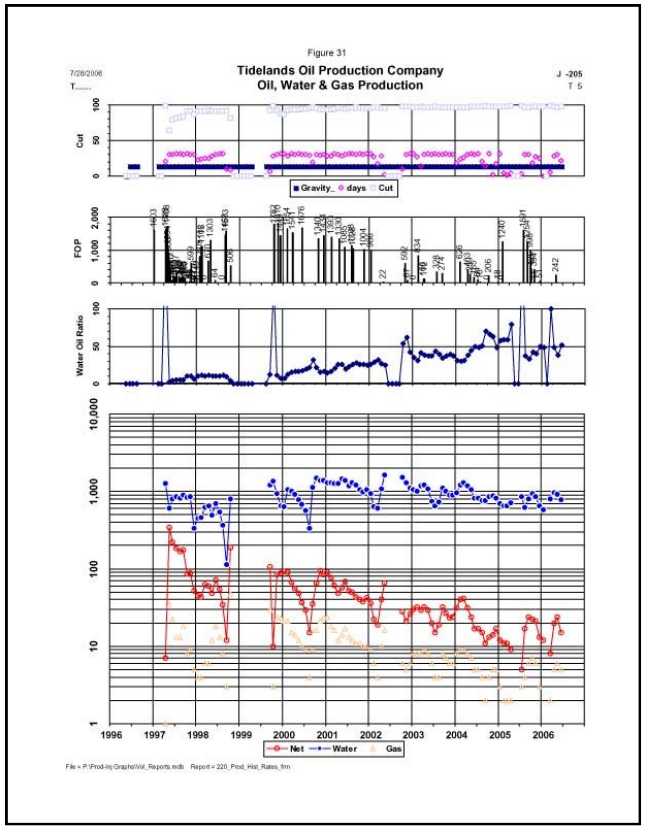
The post-steamflood cold-water injection has essentially watered out the original horizontal steamflood producer wells J-201, J-203 and J-205 because they were completed at the bottom of the S4 sands. Only well J-201 remains at 25-30 BOPD and 1740 BPD gross fluid (98.5% water cut). Oil production was maintained for a few years at about 200 BOPD by repairing and continually trying to pump down the horizontal wells.

Although steam and hot water injection were terminated, the pilot project still has potential for increasing heavy oil recovery as evidenced by the performance of wells A-603 and A-115. Horizontal well J-205 was plugged out of the horizontal section at the bottom of the S4 sands and recompleted to the top of the S4 sands in July 2005. The objective was to avoid the high water cuts from post-steamflood water injection. The well peaked in August at 35 BOPD and 706 BPD gross fluid (95.0% water cut). Production declined to 13 BOPD and 642 BPD gross fluid in December 2005 and has fluctuated between 16-25 BOPD and 800-1000 BPD gross fluid during 2006 through June. Figure 31 is a production graph of J-205 from 1997 to June 2006. Inner liners may be installed in two horizontal producers, J-201 and J-203, so





they can be pumped off without sanding up or else they can be plugged back and recompleted to the top of the S4 sands like J-205. Oil rates could increase in horizontal well A-605 if it connects to the thermally heated oil bank nearby, although that scenario gets less likely with time. Wells A-194 and A-604 have formation damage and may be acidized to stimulate production. Additional drilling of horizontal wells may be profitable in the top of "S4" sands in the heated zone above the existing pilot horizontal wells.



Wells A-605, A-603 and A-115 are cold heavy oil producers adjacent to the pilot steamflood area. Gross fluid temperatures from the wells are normal for the Tar Zone at 120°F. The three wells have very promising oil rates and water cuts that may result in better net energy ultimate recoveries than the steamflood wells if they don't water out and their open-hole, gravel-packed, wire-wrapped screen completions survive for several years. Net energy ultimate recovery is defined as the barrels of oil recovered less the thermal btu-equivalent energy used in the EOR method to recover the oil. These wells may represent an effective alternative waterflood oil recovery mechanism that can outperform steamflooding.

2006-07 Well Work and Drilling for the Tar V Post-Steamflood Project

The plan is to drill two Tar V horizontal wells, J-131 and Z1-64, to the top of the S4 sands. The wells will be near wells A-115 and A-603 in such a manner as to form a 1200 ft by 2400 ft rectangle. Horizontal wells J-131 and Z1-64 are situated perpendicular to each other with the completion for J-131 running south to north and about 2400 ft west and parallel to well A-603, whereas the completion for Z1-64 runs west to east and about 1200 ft south and parallel to well A-115.

The offset operator for the City, Thums Long Beach Company, intends to drill similar Fault Block V Tar zone S sand horizontal wells in 2006.

ACTIVITY 1.4
OPERATIONAL MANAGEMENT

Tidelands has been applying three well completion technologies for horizontal wells, including the sand consolidation process, a gravel-packed, slotted-liner completion procedure in open-hole, and a cased-through selectively perforated well with a gravel-packed, slotted-inner liner completion. Tidelands' plan is to develop and improve all three completion methods because each has advantages depending upon the type of formation sands to complete, reservoir recovery method, existence of interbedded wet sands, and availability of steam or heated fluid sources. Having viable and continuously improved completion options will be a key factor in successfully producing more complex customized wells that are drilled and completed to tap specifically targeted oil sands.

Activity 1.4.1. - Sand Consolidation Well Completion Method

The sand consolidation well completion empirically developed by Tidelands has many advantages over the conventional gravel-packed, slotted–liner completions, including lower capital costs, higher fluid productivity, more reservoir and mechanical control, relative ease and lower cost of repair, and more operational flexibility. The problems above are compounded in horizontal wells and specialized directionally drilled wells. As an example, specialized directional wells may require more extreme doglegs in the completion interval and, consequently, it is more difficult to install and center the slotted liner and to gravel pack. Such wells are found where drill sites are limited as in oilfields in urban areas, offshore platforms, and Arctic wilderness situations.

The ultimate goal is to improve the sand consolidation well completion process by strengthening the cement bonds between sand grains to withstand more differential pressure without effectively reducing formation permeability around the wellbore.

Results of Phase 1 Sand Consolidation Lab Experiments

A series of experiments were designed and performed by SUPRI-A (Stanford University Petroleum Research Institute) to determine how hot alkaline steam condensate artificially cements reservoir sands while preserving producibility as experienced in steam-completed wells in Wilmington Field. The objective of the research work was to duplicate most of the aspects of the sand consolidation well completion process in the laboratory and confirm the mineralogy of the cementing materials being created at different fluid temperatures and alkalinity and their sources of origin.

The experimental design was based upon field practices, interpretation of artificially cemented sands recovered from the tubing tail pipe of well UP-955 as described by Davies and others[5] (1997), the use of conventional cores from the Tar zone "T" and "D" sands in the Wilmington Field and temperature profile modeling. Davies and others (1997) identified three steam treatment-induced cements in the 5 mm thick tubing tail sample, namely silica, pseudohexagonal calcium silicate, and a bladed complex magnesium- and iron-bearing calcium silicate. In addition to the artificial cements, they observed oversized pores caused by dissolution of framework grains or dissolution "wormholes". These "wormholes" are thought to preserve productivity by serving as high permeability pathways through the cemented zones.

Stanford's first three experiments were performed using a stewpot filled with cleaned T sands from the Tar II-A zone and heated to 550°F. The stewpot was connected to a core holder filled with quartz sand at different temperatures for each run (Run 1 at 400°F, Run 2 at 300°F, and Run 3 at 150°F). Hot alkaline fluid based upon the composition of steam feed water used in Wilmington Field was pumped into the bottom of the stewpot and through the sand pack. Although cements were produced in all three of the experiments, the cements that were anticipated, namely calcium silicates, were not precipitated. The initial assumptions that the experimental design was based upon were reexamined.

Stanford investigated the chemistry of the rocks and reservoir fluids to determine the possible sources of the calcium silicate cements found in the tubing tail samples in well UP-955. Initial results did not generate the expected calcium silicate cements. Although the formation waters and certain sand grains (plagioclase and hornblende) contain calcium, the high survival rate of the calcium-rich grains led Stanford to believe that the calcium silicate cements were from non-reservoir sources.

Stanford reexamined the experimental design assumptions and further testing indicated the calcium silicate cements might have originated from dissolution of wellbore cements used in completing the well. They experimented by flowing hot alkaline fluids through cores consisting of various concentrations of Portland cement mixed with well-sorted quartz material at different temperatures. Stanford found they could duplicate the sand consolidation empirical process from the field in the laboratory. Their results show that it may be possible to add calcium silicate to injected hot alkaline water to consolidate formation sands in a perforated well completion.

Proposed Phase 2 Sand Consolidation Lab Experiments

The next phase of the laboratory research is to formulate and conduct experiments to optimize the geomechanical performance of the hot-alkaline-water sand consolidation process. Further laboratory work lays the underpinnings to

- lower the costs of the sand consolidation method by switching the injectant from high-quality steam to either hot water or low-quality steam thereby providing more flexibility in the operating conditions of the steam generator and the ability to burn noncommercial fuel gas instead of utility-grade natural gas;
- enable the application of the sand consolidation method to deeper and higher-pressure reservoir intervals at Wilmington, such as the Upper and Terminal zones, by using hot water injection rather than steam injection; If the gas phase is determined to be important, a non-reactive gas can be injected along with the hot alkaline fluid.
- increase the rate of success of sand consolidation as well as the longevity of treatment by developing geochemical stews for injection that improve the geomechanical strength of the grain cements and promote consolidation for the

specific conditions found at Wilmington, including formation mineralogy and fluids, formation overburden and pore pressures, and regional tectonic stresses;

- a logical progression to move from the laboratory to field tests of in-situ sand consolidation.

The primary approach to reduce the cost of sand consolidation completions is to minimize energy costs. Changing from 600°F, 80% quality steam to 600°F, 0% quality hot water reduces energy costs by about 50%. Further energy savings are achieved by first reducing the volume of hot alkaline water needed to treat a 0.25" perforation below the 750 BCWESPD steam per perforation derived by the empirical field method and second reducing the temperature of the hot alkaline water to the minimum required to form the geochemical stew.

For practical purposes, we will conduct lab tests with cores that mimic field conditions in order to create consolidated sand samples similar to the formation sand grains surrounding the perforation tunnels. The sand samples will be analyzed to confirm the mineralogy of the cements created, the formation of secondary porosity from sand grain dissolution, the creation of worm-holes from gas-induced, high-velocity fluid injection rates, and the geo-mechanical strength of the grain cementing bonds. Most downhole tools for measuring the above parameters in actual wells require destructive testing of sand-consolidated perforations or provide uncertain, conditional or insufficient results, all at relatively high acquisition costs. Thus, laboratory tests are vital to further development of this completion method.

The project is designed to help field engineers delineate criteria that indicate successful treatment in the field. The Phase 1 laboratory results suggest that a more effective means to achieve consolidation is to inject a high-temperature geochemical solution already containing the key ingredients for consolidation. Thus, the first task will be the development of "geochemical stews" at different temperatures and calcium silicate concentrations that are low cost and field applicable. Significant solubility is needed over a range of temperatures.

The effectiveness of various formulations will be verified in the laboratory for (i) permeability retention, (ii) compressive strength, and (iii) permanence. A test variant is to co-inject geochemical stews with inert nitrogen gas to increase fluid velocity and sand grain contact to assist reservoir permeability retention. Permeability retention will be measured by pressure drop across the core sand pack. Permanence to flow and chemical treatments is gauged after consolidation. At the end of a given consolidation experiment, injection is switched to a cool, brine solution at the outlet and permeability measured again as a function of time. This reversed injection continues for several hundred pore volumes thereby simulating the production of fluid moving through the pore space close to perforations. Injection rates can be ramped up to test permanence at high rates. Chemical permanence is tested by exposing consolidated sand to typical acids (15% hydrochloric) used for well and formation cleanup. The suite of chemicals tested can be expanded, if needed. Compressive strength is best measured in a triaxial cell. Samples will be tested for various moduli of interest as a function of stress/strain.

Image analysis at a variety of length scales is also planned to gauge the effectiveness of consolidation. It is also employed as a means to interpret the morphology of consolidated grains. Specific imaging and image analysis items include:

- The use of X-ray CT (computed tomography) to visualize and measure the distribution of porosity along the sand packs before and after each experiment. Again, these measurements confirm that the process has few negative effects on a formation.
- Samples of the sand-pack grains are taken after porosity is measured and examined under a scanning electron microscope (SEM). These images yield the mode of consolidation and the type of cements/precipitates as a function of temperature. Other compositional methods will be employed as needed including petrographic, XRD, XRF, and microprobe analyses.
- Samples of the effluent are collected and their elemental concentrations are measured using ICP spectroscopy.

One advantage of the hot water process, as opposed to steam injection, is that feedwater to the boiler does not need to be fresh and soft to prevent scaling. An extension of the laboratory task is to test the injection of alkaline solutions made from produced water as opposed to fresh water piped from utility water mains. Time and funding permitting, this aspect will be pursued as it lays one of the foundations to move from pilot-scale to field-wide implementation. If time does not permit this work, it should be pursued at some future date.

This project is a coordinated laboratory investigation leading to an improved process for consolidating unconsolidated and weakly consolidated oil-reservoir sands. One or two wells would be recompleted and given sand consolidation jobs based on the results of the laboratory work. The second phase of laboratory research should start in 2006 and may extend past the contract date. Costs incurred after the contract date would be covered by Tidelands and the City of Long Beach.

Activity 1.4.2. Shale-Temperature Core Work

Tar II-A Reservoir Temperatures and Formation Compaction

The City of Long Beach (City) and Tidelands Oil Production Company (Tidelands) implemented an intensive formation temperature profile and formation compaction study throughout the Tar II-A post-steamflood project from October 2005 to February 2006. The surface lands above the Tar II-A steamflood area started to subside in 1993 after steamflood peak production and formation of the updip steam chests. The surface lands have continued to subside during the remaining years of the steamflood project from 1993-1998 and over the seven-year life of the post-steamflood project through March 2006, with specific survey markers subsiding a maximum of about two feet. The surface subsidence is occurring where the land is at sea level; therefore it can adversely affect the current structures in the area. Also, the Port of Long Beach (POLB) is planning to use the subject surface lands for future port operations.

The formation compaction study utilized Schlumberger's Reservoir Saturation Tool (RST) and gamma ray (GR) cased-hole logs to compare with the original induction – spontaneous potential – GR logs for determining the affected depth intervals and extent of thermal-related formation compaction. Previous RST logs run in two wells since 1998 indicate significant formation compaction in the Du sand and shale interval between the T and D sands in the former steam chest areas. This study involved running RST logs in thirteen wells located throughout the areal extent of the Tar II-A steamflood. The temperature surveys were run to determine reservoir temperature changes and heat movement through the T and D1 steamflood sands from the start of the post-steamflood phase in January 1999 through February 2006. The temperature surveys also would show the current formation temperatures of the sands above and below the steamflooded sands.

Preliminary analysis by Tidelands indicates Tar zone compaction ranging from zero to a few feet from the top of the S subzone to the top of the Ranger F subzone. Generally, the worst compaction occurred in nine wells between the top of the Du subzone to the top of the D1 sands in the Phase 1, 1-A, and 1-B areas where the D1 sands are the hottest. Four wells along the structural downdip flank showed minor to no thermal-related compaction from the S to F sands.

The steamflooded T and D sands continue to cool slowly at the top of the sands but have experienced accelerated cooling at the bottom of the sands due to water injection and gravity segregation. Temperatures in the Du shales between the T and D sands have risen after 1998 when steam injection terminated because of heat transfer from the much hotter rocks above and below, which could make the shales susceptible to future formation compaction. At this point, it is probably premature to believe that hot areas over 350°F have completed compacting. Fortunately, the reservoirs are cooling over time so the risks of further compaction diminish too.

The cooler areas on the structural downdip flanks have the least formation compaction, as expected. Two downdip wells showed formation compaction in between the T5-T7 steamflood sands in the 2005 logs, which should be evaluated further. Two wells showed formation compaction between the D2-D3 sands. Any changes between the D3-F sands are probably more due to previous waterflooding than thermal effects. Only one well showed significant compaction of 2.0 ft in the D1 steamflood sands, and only one well showed minor compaction between the D1d and D2 sands. The comprehensive surveys showed less compaction within the T and D steamflood sands than expected, given the high reservoir temperatures achieved and high volumes of fluids injected and produced.

ACTIVITY 3
TECHNOLOGY TRANSFER

Introduction

The project team has continued to actively publish new papers and articles of interest to industry and to make presentations and field tours to both industry professionals and to the public. The technology transfer activities are presented by BP2 activity number for the current reporting period. Following the section on Activity 4, Project Management, is a reference section that includes a list of all of the original publications written by the project team since project inception in 1995 and follow-up articles and papers written based on original publications developed in this project.

All questions regarding the project should be referred to Scott Hara, Tidelands Oil Production Company, phone - (562) 436-9918, email - scott.hara@tidelandsoil.com.

3.1 DOE Reports

The project team is current on quarterly and annual reports from project inception on March 30, 1995 through September 30, 2006, which total 32 quarterly reports, two semi-annual reports and eight annual reports[E1-42]. The seven prior "annual" reports cover the periods 1995-96, 1996-97, 1997-2000, 2000-01, 2001-02, 2002-03, and 2004-05 (no report due for 2003-04). This "annual report" covers the period from April 1, 2005 to March 31, 2006.

3.2 Publications

Project team publications or publications by others that are related to project team work and were written during the reporting period have been categorized by professional society, DOE, or other organizations.

3.2.1 Professional Societies

Stanford made their first technical presentation on their sand consolidation laboratory research at a Sand Control and Management US Conference sponsored by the International Quality and Productivity Center on July 21-22, 2004 at the Doubletree Post Oak Hotel in Houston, Texas. They subsequently wrote SPE Paper #92398 entitled "A Laboratory Investigation of Temperature Induced Sand Consolidation", and presented it at the 2005 SPE Western Regional Meeting from March 30-April 1 in Irvine, CA[A-43].

Tidelands, the City and USC presented SPE Paper #94021 about the new Tar II-A horizontal well UP-957 entitled "Applying a Reservoir Simulation Model to Drill a Horizontal Well in a Post-Steamflood Reservoir, Wilmington Field, California" at the Society of Petroleum Engineers' 2005 Western Regional Meeting from March 30 - April 1 in Irvine, CA[A-44].

Geologic consultant, Vivian Bust, and Tidelands presented SPE Paper #94259 entitled "Analytical Technique for Allocating Production to Subzones to Evaluate Prospect Candidates in the Terminal Zone of Fault Blocks III/IV, Wilmington Field, CA.," at the Society of Petroleum Engineers' 2005 Western Regional Meeting from March 30 - April 1 in Irvine, CA[A-45]. This paper presented a geologic and reservoir engineering model created for the Wilmington Field Fault Block IV Terminal zones that visualizes reservoir drainage by formation subzones, which provides a quick screening technique for identifying new development well prospects.

Tidelands and Spec Services, Inc. presented SPE Paper #93993 entitled "Achieving Low Emissions in an Internal Combustion Engine Using Off-Spec Produced Fuel Gas," at the Society of Petroleum Engineers' 2005 Western Regional Meeting from March 30 - April 1 in Irvine, CA[A-46]. This paper presented the development of internal combustion engines used in Wilmington oilfield operations that can burn variable low-quality BTU gas resulting in low air pollutant emissions.

3.2.2 Industry Trade Journals and Newspapers

The project team had two publications become the bases of articles in trade journals. Stanford's SPE paper #92398 entitled "A Laboratory Investigation of Temperature Induced Sand Consolidation" was peer-reviewed and published in the June 2006 issue of the *SPE Journal*, one of the most prestigious technical publications by the Society of Petroleum Engineers[B19].

Tidelands' SPE paper #94021 about the new Tar II-A horizontal well UP-957 entitled "Applying a Reservoir Simulation Model to Drill a Horizontal Well in a Post-Steamflood Reservoir, Wilmington Field, California" was summarized and rewritten as a magazine article in the July 2006 issue of the American Oil and Gas Reporter, an independent industrial trade publication that serves as the Official Publication for 28 oil and gas associations, including the California Independent Petroleum Association, of which Tidelands and the City are members[B20].

3.2.3 DOE Symposium Proceedings

No activity reported this period.

3.2.4 Professional Society Newsletters / Mailing List

The U. S. DOE and Tidelands wrote a *Fossil Energy Techline* article entitled "DOE-Funded Project Revives Aging California Oilfield" on Mach 10, 2006[B18]. The article discussed how the DOE Wilmington Field project operated by Tidelands has created new technologies and companies to benefit both oil and gas recovery in the Wilmington Field as well as domestic and worldwide supplies. The *Fossil Energy Techline* is published by the U. S. DOE and provides updates of specific interest to the fossil fuel community.

3.2.5 Database Files

Tidelands is in the process of downloading production and injection volumes for each well in the Wilmington Field into a Dynamic Surveillance System™ (DSS) database by Landmark. Data includes well and fluid and injection volumes from field inception in 1938 to 2006. All data still requires confirmation before using. Tar II-A database is complete and confirmed through June 2006.

3.3 Presentations

Presentations on project-related technical work given during the current reporting period are categorized by PTTC, professional society, DOE, or other organizations.

3.3.1 Professional Societies

SPE/AAPG-organized Oral Presentations

See publications – industry organizations under activity 7.2.1.

3.3.2 Industry Organizations

In cooperation with the West Coast Petroleum Technology Transfer Council (PTTC), Richard Finken of the City of Long Beach coordinated the 2005 and 2006 COMET programs held from June 27-31, 2005 and June 25-30, 2006 to introduce the brightest high school 11th graders to the energy industry, with emphasis on the oil and gas industry. COMET is held at the University of Southern California and selected students live on campus for a week of classes and field trips presented by professors and industry professionals. The California-based oil and gas companies sponsor the student fees for the program. Scott Hara of Tidelands Oil Production Company helped to coordinate the programs.

3.3.3 Non-oil Industry Organizations

Scott Hara of Tidelands Oil Production Company made numerous presentations to the public about the petroleum industry, most specifically addressing world and domestic energy supplies to middle school, high school, university classes and engineering societies and to teachers. Presentations during the report period were made at Long Beach Polytechnic High School on February 23, 2005, February 24, 2006 and at Brightwood Elementary School on April 15, 2005 and May 19, 2006, and to the Tau Epsilon Pi society members at USC on March 31, 2006. He made hands-on presentations about the earth sciences and read a book to first graders at the International Elementary School in Long Beach on May 17, 2006 and to Garfield Elementary School in Alhambra, CA on June 9, 2006. Tidelands hosted several onsite tours and classes to teachers and students. A special class was held for the science teachers attending the National Science Teachers Association convention in Long Beach on April 6, 2006. A class was held on July 7, 2006 for the John Hopkins

University pilot summer engineering program being held at the California State University at Long Beach Engineering School for bright high school students.

Scott Hara of Tidelands Oil Production Company is currently a State-wide Board of Director of the California Math, Engineering and Science Achievement (MESA) program. MESA is a University of California-based academic preparation program whose primary mission is to increase the number of educationally disadvantaged students into technology-based professions that require four-year degrees in engineering and other math-based scientific fields. Tidelands sponsors his expenses related to participating in MESA activities.

3.4 Technology Awards

Scott Hara of Tidelands Oil Production Company received a 2006 Diploma of Honor from the University of Southern California, Pi Epsilon Tau National Petroleum Engineering Honor Society on March 31, 2006 "For Outstanding Service to the Petroleum Industry".

3.5 Web Site and CD-ROM Projects

The U. S. DOE is coordinating an effort to create a CD of this Tidelands and City of Long Beach DOE project to distribute to the public and government agencies to showcase some of the technologies developed in the DOE Class III reservoir program.

3.6 Field Tours

See non-oil industry organizations in Activity 7.3.3.

ACTIVITY 4
PROJECT MANAGEMENT

4.1 and 2 Executive Committee and Steering Committee

The Executive and Steering Committees are active in supporting the operation of the Tar II-A and Tar V thermal projects and committing to the technology transfer aspects of this DOE project. In fact, as of the end of the reporting period, the Project Team partners have published more original papers and given more presentations to industry and non-industry groups than any other DOE Class Project.

REFERENCES

The following references were either developed or used in this project and are grouped in categories from "A" to "E". The list is comprehensive as it includes the key references starting from project inception in March 1995. References in "A", "B", and "E" below provide all of the original papers, commercial publications, and DOE-related reports, respectively, of original technical work completed throughout the project or in progress. References in "C" below are poster and oral presentations that were given and from which no published references were developed. References in "D" below were key references cited in this or previous DOE reports that were developed outside of this project.

A. Papers, Articles, Reports, CD-ROMs, Web Sites, and Other Original Technical Work Generated by DOE Project Team

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[B20.] P. Scott Hara, Tidelands Oil Production Company, Julius J. Mondragon, H. Henry Sun, City of Long Beach, Zhengming Yang, EXGEO (CGG Venezuela), and Iraj Ershaghi, University of Southern California wrote an article entitled, "3-D Modeling Leads to Horizontal Well", based on SPE Paper #94021 entitled "Applying a Reservoir Simulation Model to Drill a Horizontal Well in a Post-Steamflood Reservoir, Wilmington Field, California", *American Oil & Gas Reporter* (pages 68-79), July 2006.

C. Presentations, Poster Sessions, Tours, and Other Activities from which No New Published Materials were Generated

[C1] Davies, D. K., Core photo description work for Tidelands Oil Production Company, 1995.

[C2] Donald D. Clarke (City of Long Beach), Chris C. Phillips (Tidelands Oil Production), Linji An (University of Southern California), "Horizontal Wells in a Clastic Oil Field with Intraformational Compaction", poster session presentation at the 1997 American Association of Petroleum Geologists (AAPG) Annual Meeting in Dallas, TX, 7-9 April.

C3 Iraj Ershaghi, Linji An (University of Southern California), Donald D. Clarke (City of Long Beach), Chris Phillips (Tidelands Oil Production), "Sealing Behavior of Normal Faults in Fault Block II, Wilmington Oil Field, California", poster session presentation at the 1997 American Association of Petroleum Geologists (AAPG) Annual Meeting in Dallas, TX, 7-9 April.

C4 Jeff Schwalm, John Perry (Dynamic Graphics Inc.), "3-D Geologic Modeling: Theory and Application", a half day workshop sponsored by the PTTC at USC Campus, Los Angeles, CA on 2 May 1997. Presentation utilizes 3-D Deterministic Geologic Model from this project to explain fundamentals of 3-D Geologic Modeling.

C5 Donald D. Clarke (City of Long Beach), Chris C. Phillips (Tidelands Oil Production), Linji An (University of Southern California), "Tertiary Development of Heavy Oil Sands through Thermal Recovery in the Wilmington Oil Field, California: An Update and Some New Challenges", Oral presentation at the 1997 American Association of Petroleum Geologists (AAPG) Pacific Section Convention in Bakersfield, CA, on 14-16 May.

C6 Donald D. Clarke (City of Long Beach), Chris C. Phillips (Tidelands Oil Production), Linji An (University of Southern California), "Reservoir Characterization Using Advanced 3-D Computer Modeling Technology: A Case Study of the Fault Block II in Wilmington Field, California", Electronic poster session at the 1997 American Association of Petroleum Geologists (AAPG) Pacific Section Convention in Bakersfield, CA, 14-16 May.

C7 M. Hassibi, Iraj Ershaghi (University of Southern California), "Characterization of Lithological Log Responses in Turbidite Series using Neural Networks", oral presentation at the 1997 American Association of Petroleum Geologists (AAPG) Pacific Section Convention in Bakersfield, CA, 14-16 May 1997.

C8 David K. Davies, Richard K. Vessel (David K. Davies and Associates), "Geological Controls on Permeability Distribution and Sand Distribution: Tar Zone, Fault Block II-A, Wilmington Field", oral presentation at the 1997 American Association of Petroleum Geologists (AAPG) Pacific Section Convention in Bakersfield, CA, 14-16 May.

C9 Donald D. Clarke (City of Long Beach): Project status presentation for DOE/BDM conference regarding status of all DOE contracted projects, Houston, TX, 16-20 June 1997.

C10 Julius Mondragon III, Scott Hara (Tidelands Oil Production), "Novel Sand Consolidation Completion Technique Using Alkaline-Steam Injection in the Tar Zone, Wilmington Field", SPE GEM Presentation WR GEM 29, 1997 Western Regional Meeting in Long Beach, CA 23-27 June.

[C11] Chris Phillips, Scott Hara (Tidelands Oil Production), "Three-Dimensional Geological Modeling as a Cost-Effective Tool for Horizontal Drilling", SPE GEM Presentation WR GEM 6, 1997 Western Regional Meeting in Long Beach, CA 23-27 June.

[C12] Mark Kapelke (Tidelands Oil Production), "How to Work With the DOE" and "Multimedia and Technical Transfer", National Petroleum Technology Resource Center sponsored by the DOE, 1997 Western Regional Meeting in Long Beach, CA 23-27 June.

[C13] Phillips, C. C. and L. An, supporting all faults and surfaces files for USC, 1997, Cheng, A., *GOCAD Manual*, GOCAD Consortium, Nancy Geological School, August, 1997.

[C14] Du, C., University of Southern California, West Coast PTTC staff, organized short course entitled "GOCAD^{++} Training" and made a presentation during the course, November 14, 1997 at USC campus.

[C15] Hara, S., Tidelands Oil Production Company, reprised sand consolidation well completion presentation - SPE paper 38793, SPE Los Angeles Basin Section New Technology and Environmental Forum meeting, November 19, 1997, Long Beach Petroleum Club.

[C16] Ershaghi, I., University of Southern California, Clarke, D., City of Long Beach, West Coast PTTC staff: Organized geologic short course and field trip on "Turbidite Reservoirs in California", November 24, 1997, Ventura, CA.

[C17] Tidelands Oil Production Company gave a short presentation of the two Wilmington Class III projects to Guido DeHoratiis of the DOE on December 4, 1997 in Tidelands' office.

[C18] Clark, D., City of Long Beach, Phillips, C., Tidelands Oil Production Company, "Subsidence and Old Data Present Unique Challenges in Aging Turbidite Oil Fields. Examples of Successful Technologies Solutions from the Wilmington Oil Field, California, USA", 3rd AAPG / EAGE Joint Research Conference on Developing and Managing Turbidite Reservoirs: Case Histories and Experiences, Almeria, Spain, 4-9 October 1998.

[C19] Du and Nadim, Shale mapping of D1 interval, FBIIA, Petroleum Engineering Program, Dec. 1998.

[C20] Scott Hara gave an oral presentation entitled "Steamflooding Recovery of a Class 3 Reservoir – DOE's Cooperative Efforts with Independent Producers to Enhance Production While Maintaining Safe and Environmentally Compatible Operations" at the Technology Assessment & Research Program's Technology Seminar held on

May 19, 1999 at the office of the U. S. Minerals Management Service in Camarillo, CA.

[C21] Same as (C18), but given at 1999 EAGE Conference and Technical Exhibition, Helsinki, Finland, June 7-11.

[C22] Same as (C18), but given at 1999 AAPG/SPWLA Hedberg Research Symposium, The Woodlands, TX, October 10-13.

[C23] Clarke, Donald D., City of Long Beach, “At 68, Wilmington Still Has Life: New Technology Revitalizes the Old Field”, 1999 AAPG/SPWLA Hedberg Research Symposium, The Woodlands, TX, October 10-13.

[C24] Scott Hara reprised his presentation entitled “A Well Completion Technique for Controlling Unconsolidated Sand Formations by Using Steam” at two West Coast Petroleum Technology Transfer Council (PTTC) workshops on “Sand Control for California Oilfield Operations” given in Long Beach, CA on November 18, 1999 and in Bakersfield, CA on November 19, 1999.

[C25] Scott Hara made an oral presentation summarizing this DOE project’s achievements related to reservoir and operational management and technical transfer of steamflood experience to the Wilmington Fault Block V Tar zone. The presentation was given at the West Coast PTTC Annual Forum held on the USC campus on December 10, 1999.

[C26] Scott Hara, Tidelands, reprised presentation “A Well Completion Technique for Controlling Unconsolidated Sand Formations by Using Steam”, 2000 IPAA Mid-year Meeting, San Francisco, CA, May 18-20.

[C27] Don Clarke, City of Long Beach, reprised oral presentation “At 68, Wilmington Still Has Life: New Technology Revitalizes the Old Field”, 2000 Pacific Section AAPG/SPE Western Regional Meeting, Long Beach, CA, June 19-22.

[C28] Scott Hara nominated and helped prepare application for the 2001 Pacific Section AAPG Teacher of the Year Award Winner, Mr. John Jackson, of Monterey Highlands Elementary School, Monterey Park, CA. Mr. Jackson was presented the award at the 2001 PSAAPG Annual Meeting, Universal City, CA, April 10.

[C29] Hara, Scott, Tidelands Oil Production Company, “Applying New Technology to an Old Field”, California Conservation Committee of Oil and Gas Producers, Long Beach, CA, 19 September 2001.

[C30] Hara, Scott, Tidelands Oil Production Company, “Applying New Technology to an Old Field”, Stanford University Petroleum Engineering Dept., Stanford University, CA, 2 November 2001.

[C31] Hara, Scott, Tidelands Oil Production Company, "World Oil and Gas Reserves and Recovery Methods", Geology classes, Long Beach Polytechnic High School, Long Beach, CA, 13 March 2002.

[C32.] Don Clarke, City of Long Beach, "2003 Mayor's Environmental Forum", Will Rogers Middle School, Long Beach, CA, March 2

[C33.] C.M. Ross, E.R. Rangel_German, L.M. Castanier and A.R. Kovscek, Stanford University, P.S. Hara, Tidelands Oil Production Company, "A Laboratory Investigation of Temperature Induced Sand Consolidation", Sand Control and Management US Conference sponsored by the International Quality and Productivity Center, Doubletree Post Oak Hotel, Houston, TX, July 21-22, 2004.

[C34] Scott Hara, Tidelands Oil Production Company, "Historical Look at Petroleum Industry in LA", 2005 COMET program at University of Southern California, June 27.

D. Key Outside References Related to Project and Cited in Current or Previous DOE Reports Listed in Section E

[D1] Small, G.P., Shell California Production Inc. "Steam-Injection Profile Control Using Limited-Entry Perforations", SPE Paper 13607, presented at the 1985 California Regional Meeting in Bakersfield, CA, March 27-29 1985.

[D2] R.M. Butler, "Gravity Drainage to Horizontal Wells", *Journal of Canadian Petroleum Technology*, Volume 31, No. 4, pages 31-37, April 1992.

[D3] F.H. Lim, W.B. Saner and W.H. Stillwell (Union Pacific Resources Co.) and J.T. Patton (New Mexico State University), "Steamflood Pilot Test in Waterflooded, 2500 ft. Tar Zone Reservoir, Fault Block II Unit, Wilmington Field, California", presented at the 1993 Society of Petroleum Engineers Annual Technical Conference and Exhibition in Houston, TX, 3-6 October 1993.

[D4] R.M. Butler, *"Horizontal Wells for the Recovery of Oil, Gas and Bitumen; Monograph 2"*, Petroleum Society of CIM, Calgary 1994.

[D5] M. Polikar, D.A. Redford, "Evolution of Steam-Based Technology for the Recovery of Canadian Heavy Oil Reservoirs", *Journal of Petroleum Technology*, Volume 34, No. 5, pages 33-40, May 1995.

[D6] Ershaghi, I., Omoregie, O., University of Southern California, "A Method for Extrapolation of Cut Vs. Recovery Curves," *Journal of Petroleum Technology*, pages 203-04, February 1978.

[D7] Ershaghi, I., Abdassah, D., University of Southern California, "A Prediction Technique for Immiscible Processes Using Field Performance Data," *Journal of Petroleum Technology*, pages 664-70, April 1984.

[D8] George E. Ottot, Tom F. Norton, Thums Long Beach Company, "The Stratigraphy of the Wilmington Field", Pacific Section American Association of Petroleum Geologists, Field Guide Book entitled "Old Oil Fields and New Life: A Visit to the Giants of the Los Angeles Basin"[A7], 1996 AAPG Annual Meeting, San Diego, CA, May 18-22

[D9] M. N. Mayuga, City of Long Beach, "Geology and Development of California's Giant - Wilmington Oil Field", American Association of Petroleum Geologists Memoir No. 14, 1970.

[D10] Ershaghi, I., Handy, L.L., and Hamdi, M.: "Application of the X-Plot Technique to the Study of Water Influx in the Sidi El_Itayem Reservoir, Tunisia," JPT (Sept. 1987) 1127-36.

[D11] Slatt, R. M., S. Phillips, J. M. Boak and M. B. Lagoe, ``Scales of Geologic Heterogeneity of a Deep-Water Sand Giant Oil Field, Long Beach Unit, Wilmington Field, California'', in E. G. Rhodes and T. F. Moslow (eds.), *Frontiers in Sedimentary Geology: Marine Clastic Reservoirs: Example and Analogues*, Springer-Verlag, 1993.

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[D13] Zeito, G. A., "Interbedding of Shale Breaks and Reservoir Heterogeneities", JPT, Oct. 1965. 1223 - 1228.

[D14] Weber, K. J., "Influence of Common Sedimentary Structures on Fluid Flow in Reservoir Models", JPT, March 1982, 665 - 672.

[D15] Haldorsen, H. H and L. W. Lake, "A New Approach to Shale Management in Field-Scale Models", SPEJ, Aug. 1984, 447 - 457.

[D16] Begg, S. H., D. M. Chang and H. H. Haldorsen, "A Simple Statistical Method for Calculating the Effective Vertical Permeability of a Reservoir Containing Discontinuous Shales", SPE 14271, 1985.

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[D18] Haldorsen, H. H., “On the Modeling of Vertical Permeability Barriers in Single-Well Simulation Models”, SPEFE, Sept. 1989, 349 - 358.

[D19] Deutsch, C., “Calculating Effective Absolute Permeability in Sandstone/Shale Sequences”, SPEFE, Sept. 1989, 343 - 348.

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[D24] Ostermeier, R. M., “Stressed Oil Permeability of Deepwater Gulf of Mexico Turbidite Sands: Measurements and Theory”, SPE 30606, 1995.

[D25] Slatt, R.M. and G.L. Hopkins, ``Scales of Geological Reservoir Description for Engineering Applications: North Sea Oil Field Example'', Paper SPE 18136, Presented at the 1988 Soc. Pet. Eng. Ann. Meeting, Houston, Texas, Oct. 2-5, 1988.

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[D27] Jordan, D. L. and D. J. Goggin, “An Application of Categorical Indicator Geostatistics for Facies Modeling in Sand-Rich Turbidite Systems”, SPE 30603, 1995.

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[D29] Dehghani, K., W. M. Basham and L. J. Durlofsky, “ Modeling and Scaleup of Steamflooding in a Heterogeneous Reservoir”, SPEFE, Nov. 1995, 237 - 245.

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E. Required Reports Generated for the Department of Energy

[E1] P. Scott Hara (Tidelands Oil Production), Quarterly Technical Progress Report - Class III Mid-Term Project, “Increasing Heavy Oil Reserves in the Wilmington Oil Field Through Advanced Reservoir Characterization and Thermal Production Technologies”, DE-FC22-95BC14939, (30 March 1995 - 30 June 1995).

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Field Through Advanced Reservoir Characterization and Thermal Production Technologies", DE-FC22-95BC14939, (1 July 2002 - 30 September 2002).

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[E42] Project Team, Annual Report entitled "Increasing Heavy Oil Reserves in the Wilmington Oil Field through Advanced Reservoir Characterization and Thermal Production Technologies", DE-FC22-95BC14939, (1 April 2005 - 31 March 2006).