QUARTERLY TECHNICAL PROGRESS REPORT

FOR THE PERIOD ENDING

DECEMBER 31, 2001

For DOE Grant Entitled

"ENHANCED OIL RECOVERY WITH DOWNHOLE VIBRATION STIMULATION IN OSAGE COUNTY, OKLAHOMA"

Contract Number:	**DE-FG26-00BC15191**
Contractor:	**Oil & Gas Consultants International, Inc. 4111 So. Darlington Suite 700 Tulsa, Oklahoma**
Contract Date:	**July 13, 2000**
Extended Completion:	**May 12, 2002**
Government Award:	**$675,000 (Current Year)**
Principal Investigators:	**J. Ford Brett Robert V. Westermark**
Project Manager:	**Virginia Weyland National Petroleum Technology Office**
Reporting Period:	**September 30, 2001 – December 31, 2001**

Disclaimer

Abstract

This Technical Quarterly Report is for the reporting period September 30, 2001 to December 31, 2001. The report provides details of the work done on the project entitled "Enhanced Oil Recovery with Downhole Vibration Stimulation in Osage County Oklahoma".

The project is divided into nine separate tasks. Several of the tasks are being worked on simultaneously, while other tasks are dependent on earlier tasks being completed.

The vibration stimulation well was permitted as Well 111-W-27, section 8 T26N R6E Osage County Oklahoma. It was spud July 28, 2001 with Goober Drilling Rig No. 3. The well was drilled to 3090' cored, logged, cased and cemented. The Rig #3 moved off August 6, 2001.

Phillips Petroleum Co. has performed standard core analysis on the cores recovered from the test well. Standard porosity, permeability and saturation measurements have been conducted. Phillips has begun the sonic stimulation core tests.

Calumet Oil Company, the operator of the NBU, has been to collecting both production and injection wells information to establish a baseline for the project in the pilot field test area since May 2001.

The 7-inch Downhole Vibration Tool (DHVT) has been built and has been run in a shallow well for initial power source testing. This testing was done in a temporarily abandoned well, Wynona Waterflood Unit, Well # 20-12 operated by Calumet Oil Co both in October and December 2001. The data acquisition system, and rod rotating equipment performed as designed. However, the DHVT experienced two internal failures during vibration operations. The DHVT has been repaired with modifications to improve its functionality.

A proposed technical paper abstract has been accepted by the SPE to be presented at the 2002 SPE/DOE Thirteenth Symposium on Improved Oil Recovery, in Tulsa OK, 13-17 April 2002.

A one-day SPE sponsored short course which is planned to cover seismic stimulation efforts around the world, will be offered at the SPE/DOE Thirteenth Symposium on Improved Oil Recovery in Tulsa, OK, April 13-17, 2002. Dan Maloney, Phillips and Bob Westermark, OGCI will be the instructors.

TABLE OF CONTENTS

List of Graphical Material

Introduction

The objective of this project is to demonstrate the impact of downhole vibration stimulation on oil production rates in a mature waterflood field. Oil and Gas Consultants International, Inc. (OGCI) will manage the project in close cooperation with the Osage Tribe as the tests will be conducted in Osage County, Oklahoma, the mineral estate of the Osage Tribe. Calumet Oil Company operates the field. Phillips Petroleum Company will contribute their proprietary vibration core analysis of cores recovered from the pilot test area.

To achieve the project objectives, the work has been divided into nine tasks, some are concurrent, while other tasks rely on completion of previous steps. The initial task is a review of the North Burbank Unit field operated by Calumet Oil Company, in Osage County, Oklahoma, to determine the appropriate pilot test area. Once the pilot test area is selected, Calumet Oil Company will maintain current field operations, collecting base-line production and injection data. The team will then determine where within the pilot test area to optimally locate the vibration test well. With the location determined, the test well will be drilled, cored, logged and 7-inch production casing run and cemented.

In a parallel effort, OGCI will be designing, building, and testing a new version of the downhole vibration tool based on their patented whirling orbital vibrator. With the field test tool built to run in 7-inch casing, duration testing of the downhole tool and surface power source will be conducted in a well operated by Calumet Oil Company, near Wynona, Oklahoma.

After the core is recovered, Phillips Petroleum Company will be conducting laboratory tests utilizing their proprietary sonic core apparatus to determine fluid flow response to a range of vibration frequencies. These results, in turn, will allow final adjustments to the frequency generation mechanisms of the downhole vibration tool.

One or more offset wells, in the area adjacent to the vibration test well, will be equipped with downhole geophones to determine strength of signal and if the producing formation has a dominant frequency response. Surface geophones will also be set out and arranged to pick up the signal generated by the downhole vibration tool.

The downhole vibrator will be installed in the test well. Monitoring the production and injection for the pilot test area will continue. As the frequency of the downhole tool is changed, the recording of seismic signals, both on the surface and downhole, will also be conducted. The results of the data collection will be a matrix of varying vibration stimulation conditions corresponding to changes in production and injection fluid rates and seismic responses.

In addition to required DOE reports, the results of the downhole vibration stimulation will be prepared and delivered using several venues. Technical papers will be submitted to the Society of Petroleum Engineers and other professional organizations. Workshops are planned to be held in conjunction with the PTTC for operators in Osage County and surrounding areas. A dedicated technical session on vibration stimulation will be offered at the SPE/DOE Thirteenth Improved Oil Recovery Symposium April 13-17, 2002, bringing together the world's experts in this emerging technology. The final task will be to close out the project.

Executive Summary

Contract Status:

In August 2001, an Extended Budget Request was submitted to the DOE Contract officer Mrs. Weyland, NPTO, Tulsa office. In this request, we have asked for funding for additional tasks to be performed by Las Alamos National Laboratory (LANL) and Lawrence Berkeley National Laboratory (LBNL). The contract amendment covering the request for additional funds and extended completion date was received September 18, 2001. The executed contract amendment was sent back to DOE in November 2001.

This brings the total project budget to $1,020,500. This is with the DOE share of $675,750 and recipient share of $334,750. This will extend the budget period from November 12, 2001 to May 12, 2002.

Financial status:

During this quarter $190,095 has been dispersed with an additional $7,535 committed for work in progress.

Schedule Status:

Testing surface power source, data acquisition system and the DVHT was conducted in October and again in December 2001. The vibration stimulation of the North Burbank Unit is now scheduled to begin in February 2002. Phillips using their sonic test cell, with preliminary results expected in February 2002 is testing the cores recovered.

Technical Progress:

Vibration Stimulation Test Well Drilled

The vibration stimulation test will be conducted at the NBU field in Osage County, OK. See Fig. 1 on page 4. The pilot test area is located in Section 8 T26N R6E, please refer to Fig. 2 on the following page. The vibration stimulation test well location is 2560 ft FWL and 510 ft FSL of NW/4 of Section 8, this quarter section is known as Tract 111. The well number is Well 111-W-27. The surface of the area can been seen on the composite USGS Topographic map found in Fig. 3. The distance from the offset wells (producers, injectors and shut-in wells) to the vibration stimulation well can been seen in Fig.4.

The well was spud on July 28, 2001 and details on the drill operation can be found in the 5th Quarterly Report. Phillips has provided the results of standard core analysis, which can be found in Appendix A.

Please refer to Fig.5, which is the schematic of Well 111-W-27 with the DHVT installed.

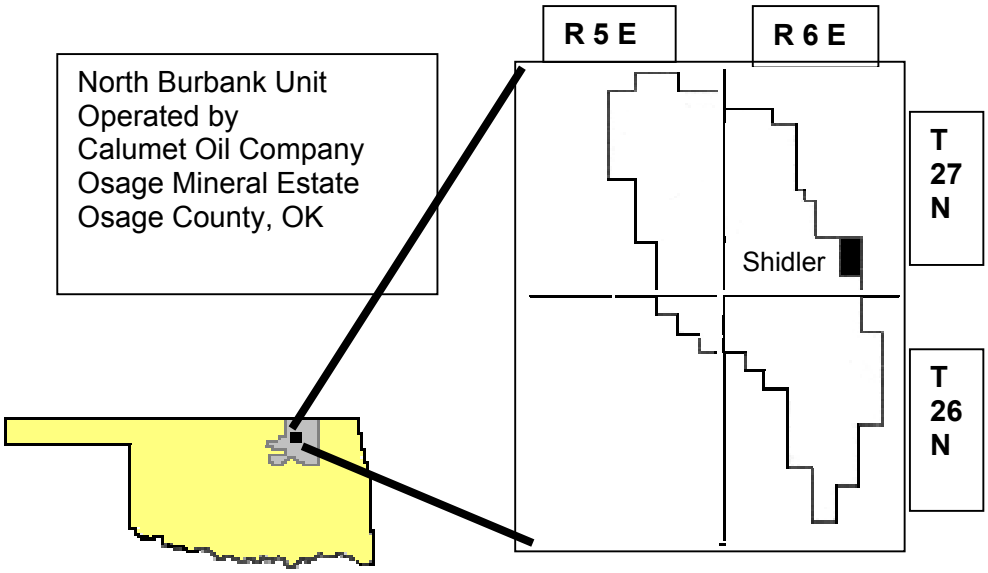


Figure 1 Location of North Burbank Unit (NBU) Field, Osage County, OK.

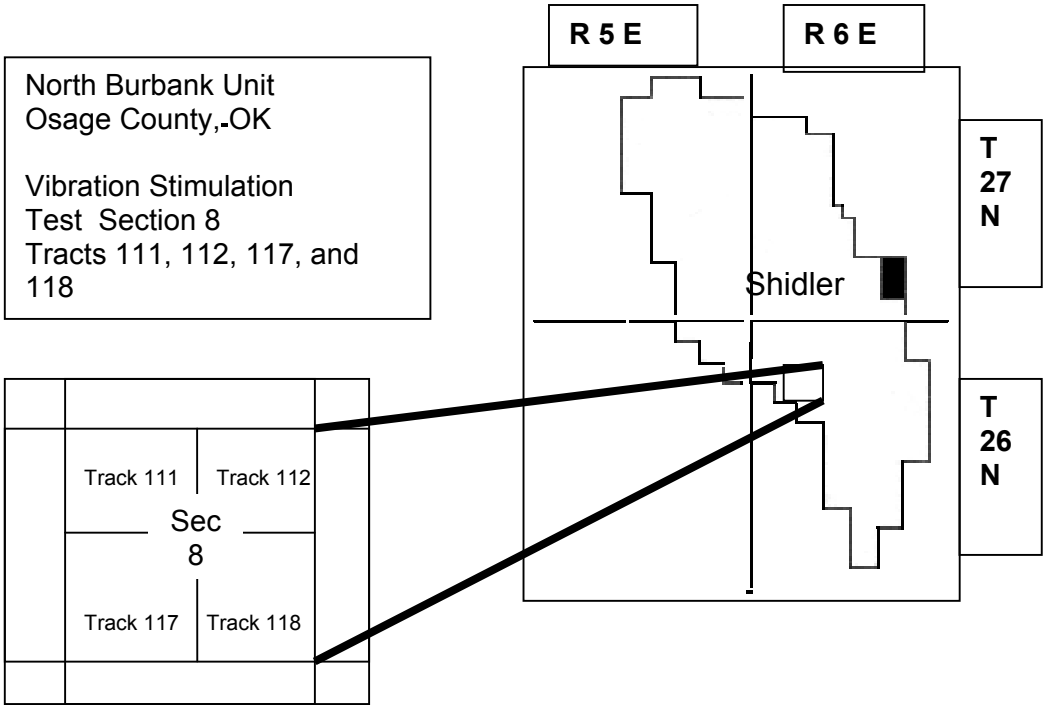


Figure 2 Section 8, Location of Vibration Stimulation Pilot Test Area in NBU Field

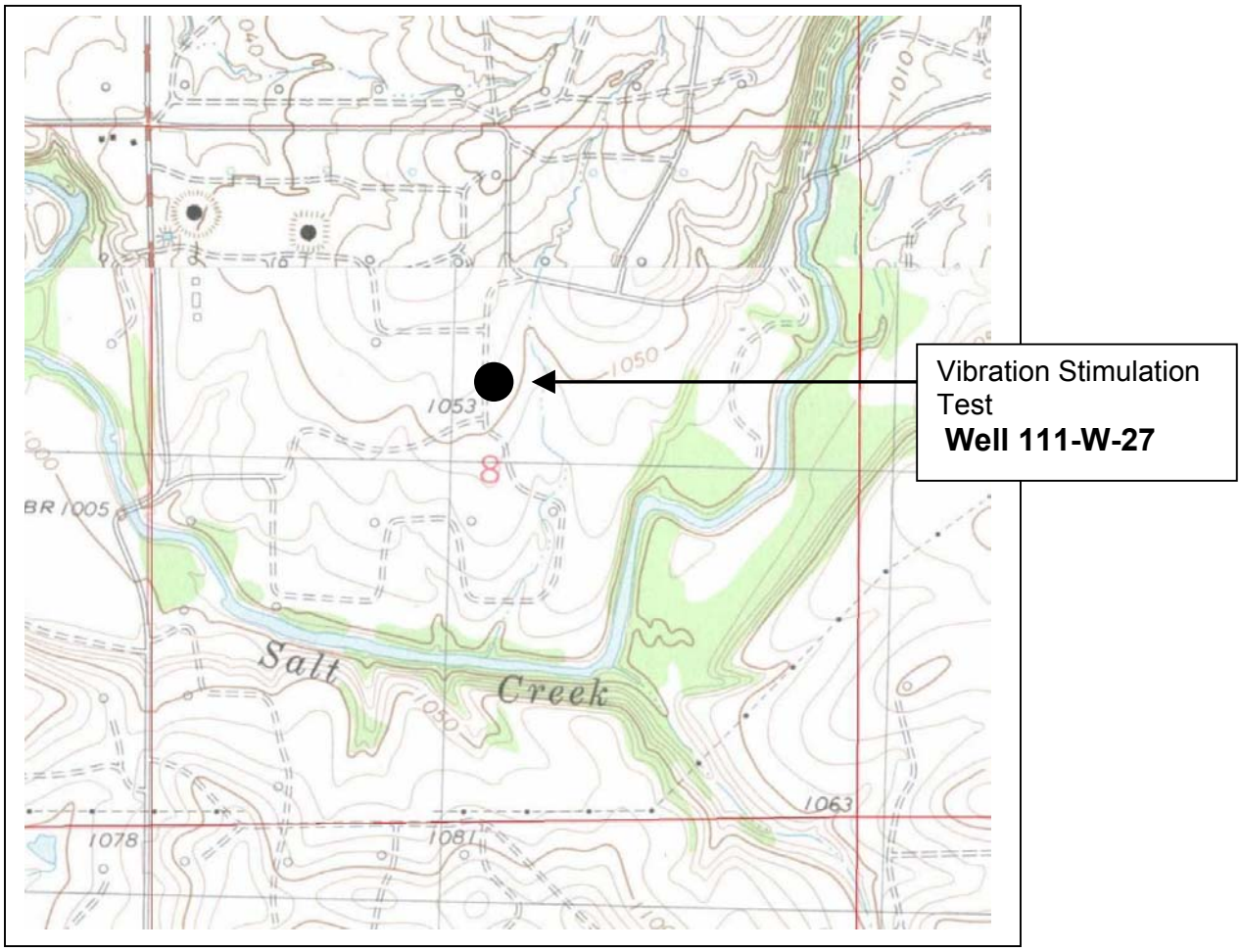


Figure 3 Section 8 T26N R 6E USGS Topographic Map, Osage County, OK.

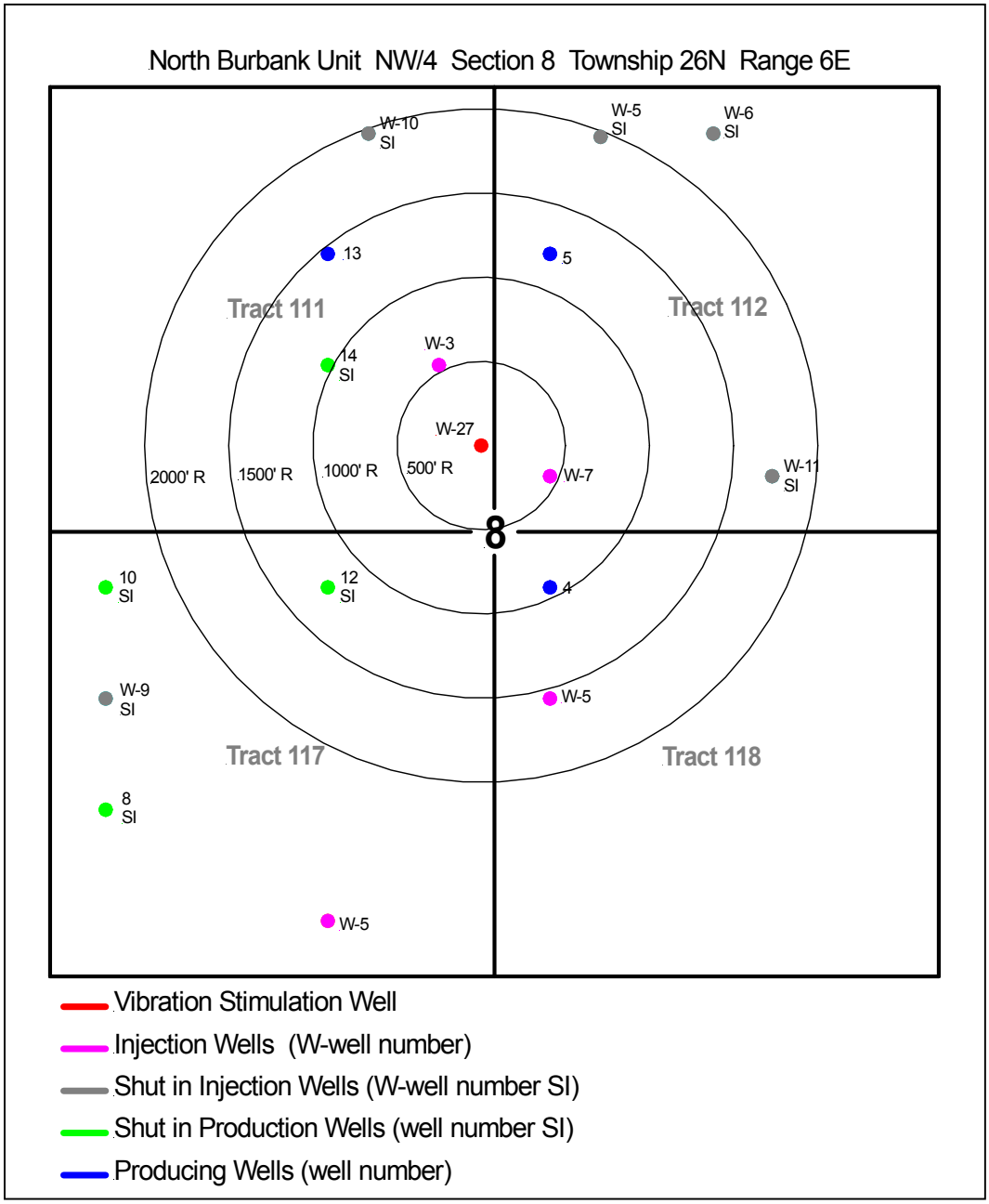


Figure 4 Current Well Locations in Section 8 T26N R6E NBU

Building and Testing the Downhole Vibration Tool

OGCI has built the 7-inch field test version of the downhole vibration tool (DHVT). In the course of improving the present tool design, a novel method of constructing the tool has been implemented. An invention disclosure was given to OGCI's patent attorneys and we plan to apply for a patent.

Field Instrumentation and Well Testing

In Fig 4 above, the approximate distance from Well 111-W-27 has been drawn in 500' radii circles. Calumet Oil Company is monitoring all wells in Section 8 to establish the baseline for production and injection characteristics for each well. They have split the flow coming into the tank battery, to be able to isolate the production from the wells in the section 8 pilot test area. The plot of daily production oil and total fluid versus total water injection can be found in Appendix C.

During the vibration stimulation operation Well 111-W-27 will be equipped with the DHVT located across the Burbank formation. A rod-rotating unit will drive the DHVT from the surface. Please refer to Fig.5 for a schematic of the well during vibration stimulation.

Lawrence Berkeley National Laboratory will be conducting the data acquisition from both the surface and downhole geophones. Plans for Ernie Major and his team to gather this data are in place. The shut-in wells in Section 8 will be candidates for downhole monitoring equipment installation. The first shut-in well to be used for downhole geophone installation is slated to be Well 111-14, which is approximately 1000' from the vibration stimulation well. A schematic of the geophone installation can be found in Fig. 6.

Conducting for the Power Source Tests

The purpose of the power source tests are to check the performance of the 7" DHVT, the controls on the rod rotating system and the data acquisition system. To be able to monitor the DHVT performance, downhole sensors have been built into the tool. These transmit data back to the surface using a multi-conductor cable strapped to the tubing. This tool data is collected with a computer in the data acquisition doghouse. Fig. 7 is a photograph of the rod rotating unit placed near the well and the doghouse, which houses the computer equipment and the controls for the rod-rotating unit.

The location for the power source tests is at the Wynona Waterflood Unit Well #12-20. Calumet Oil Company operates this Osage County waterflood unit. For a schematic of Well 12-20, please refer to Fig.8.

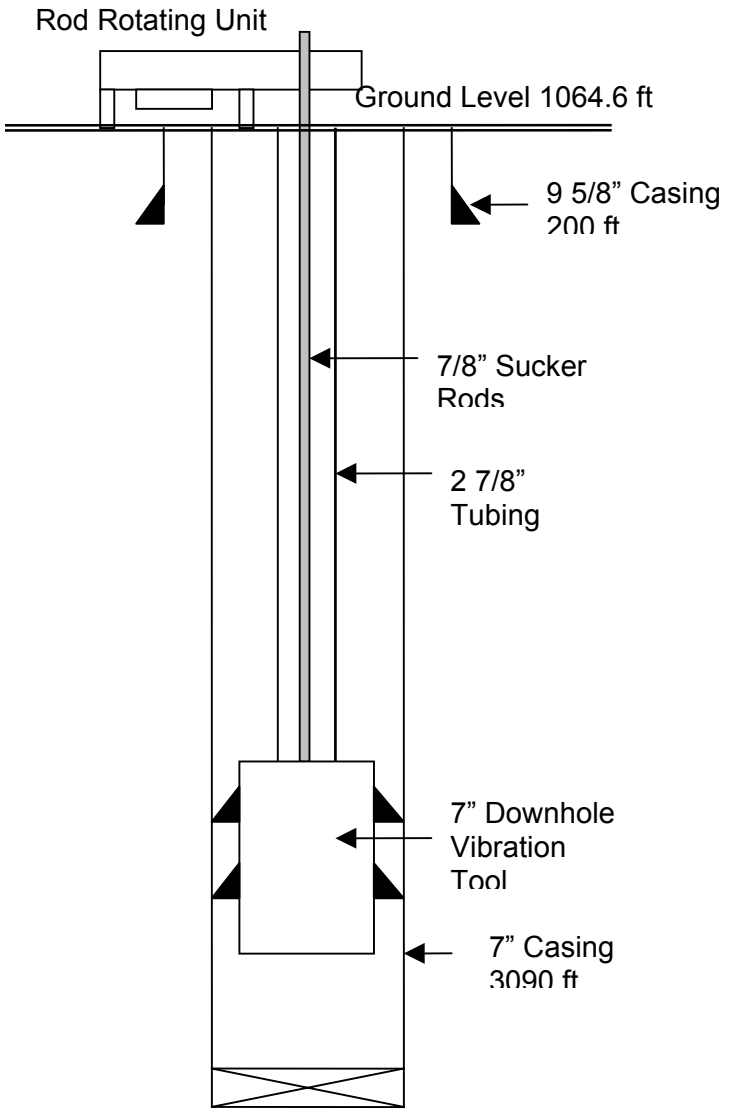
Power source tests were conducted in October 2001. Figure 9 is a photograph of the complete DHVT being picked up by the rig. The data acquisition, rod rotating and motor control systems worked satisfactorily. However the DHVT experienced a flex shaft failure due to galling on the internal rotating piece and the inside of the housing. The DHVT was repaired by inserting a hardened sleeve into the housing and by reworking and hardening the rotating mass. The DHVT was tested again in December 2002 in the Wynona well. The DHVT again experienced a flexshaft failure, this time due to higher than expected torque levels. The flexshafts have been redesigned. At the time of writing this report, the DHVT with improved flexshafts is being successfully tested at a surface test site near Tulsa.

U. S. Department of Energy

Project DE-PS26-99BC15191
"Enhanced Oil Recovery with Downhole Vibration Stimulation"
NBU Phase

NBU FIELD
WELL 111-W 27

VIBRATION STIMULATION WELL



Completion Date: **July 2001**

SURFACE CASING:

Production Casing: 7"

TD: 3090'

TOP OF BURBANK SAND:

2850 ft

Completion:

Not Completed in Burbank

Stimulation:

None

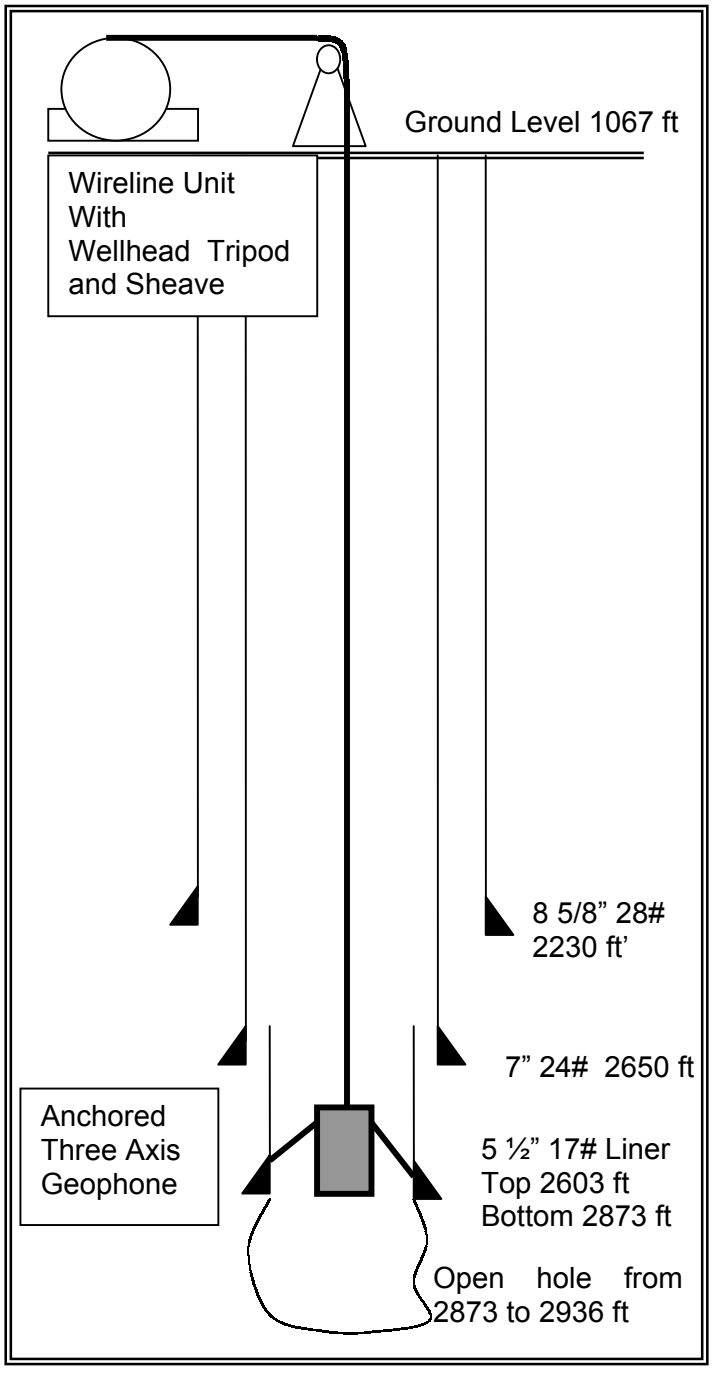
Figure 5 Schematic of Vibration Stimulation Well NBU 111-W-27

U. S. Department of Energy

Project DE-PS26-99BC15191
"Enhanced Oil Recovery with Downhole Vibration Stimulation"
N B U Phase

NBU FIELD
WELL 111-14

GEOPHONE INSTALLATION WELL



Completion Date: September 1923

SURFACE CASING:

Production Casing: 7"

LINER

TD: 2935 ft

BURBANK SAND:

2873 to 2936 ft

Completion:

Open hole from 2873 to 2936 ft

Stimulation:

Nitroglycerine

Figure 6 Schematic of Geophone Installation NBU Well 111-14

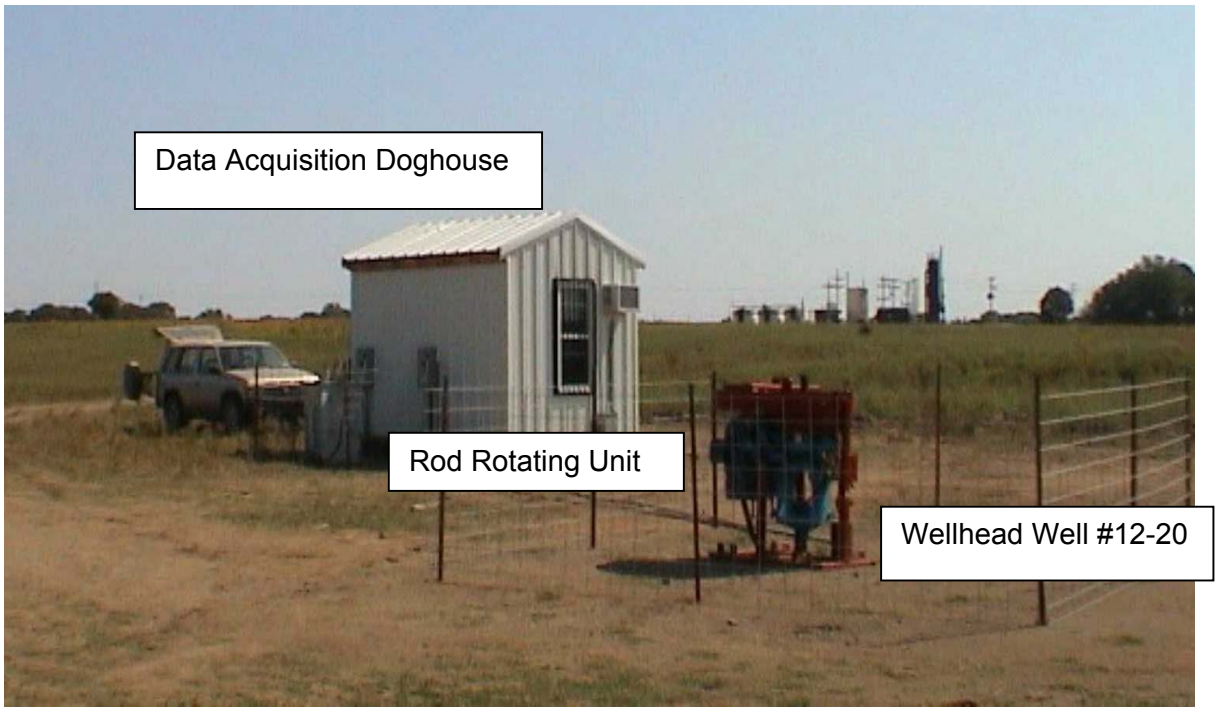


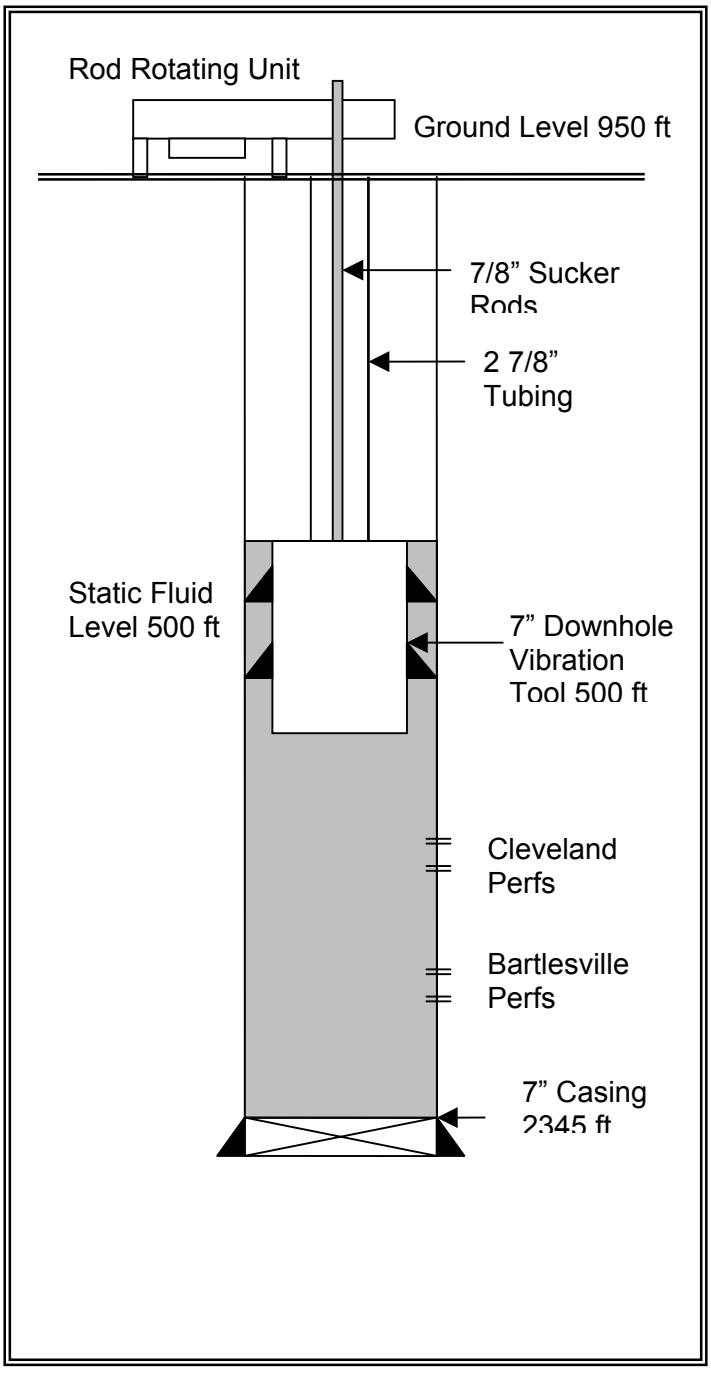
Figure 7 Data Acquisition Doghouse and Rod Rotating Unit Wynona Waterflood Unit Well 12-20

U. S. Department of Energy

Project DE-PS26-99BC15191
"Enhanced Oil Recovery with Downhole Vibration Stimulation"
NBU Phase

WYNONA WATERFLOOD FIELD
WELL 12 - 20

POWER SOURCE TEST WELL



Re-Completion Date: **2/8/80**

SURFACE CASING:

Production Casing: 7"

TD: 2351 ft

TOP OF CLEVELAND SAND:

1400 ft

TOP OF BARTLESVILLE SAND:

2050 ft

Completion:

Cleveland 1404 to 22 ft

Bartlesville 2098 to 2114 ft

Stimulation:

500 gal Acid
5000 lbs. Sand

Figure 8 Schematic of Power Source Test Wynona Waterflood Unit Well 12-20

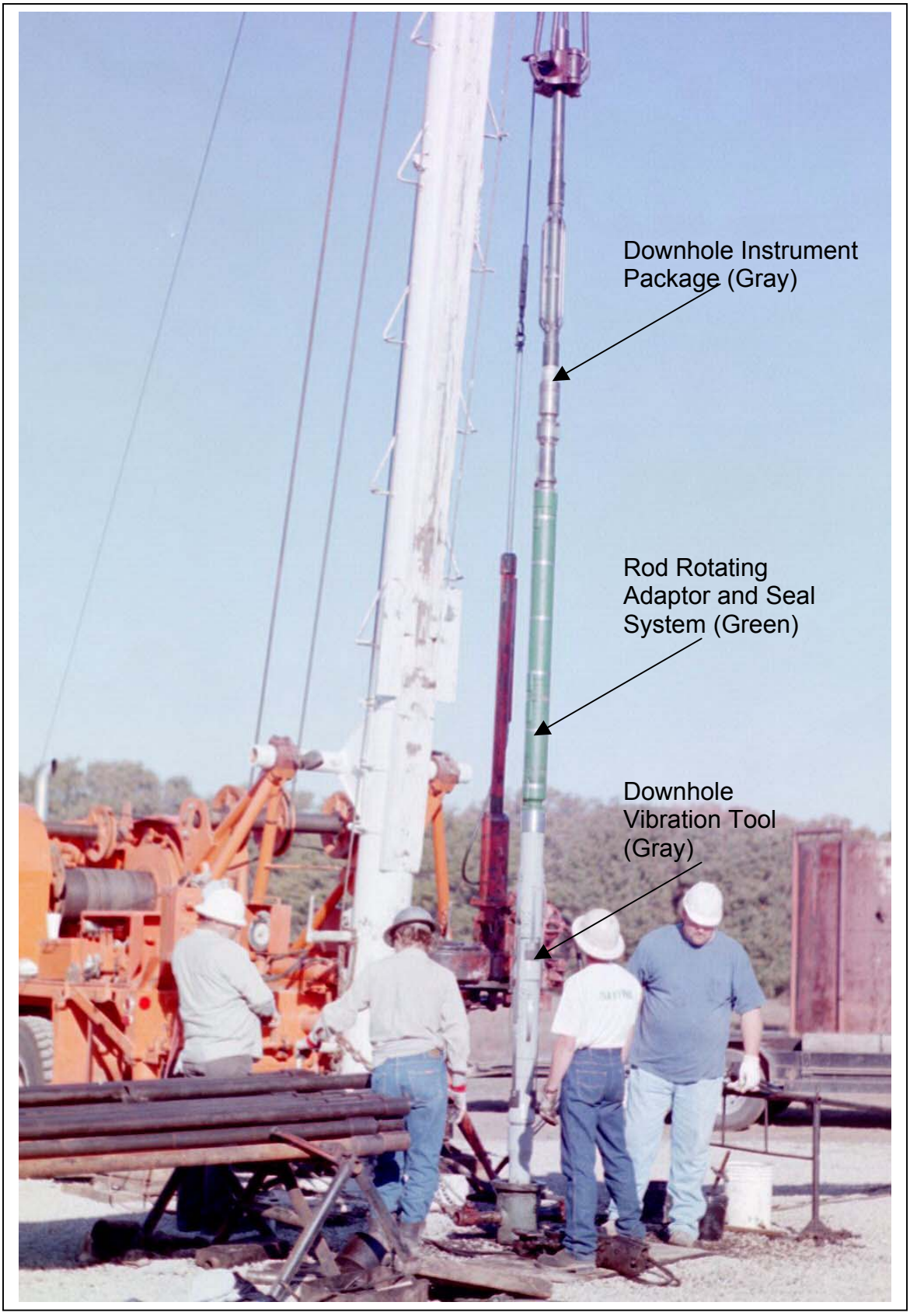


Figure 9 Running the Downhole Vibration Tool.

Results and Discussion

THIS SECTION OF THE QUARTERLY REPORT REVIEWS IN DETAIL, THE PROGRESS MADE DURING THE QUARTER ON EACH OF THE PROJECT'S MAJOR TASKS AND SUB-TASKS.

TASK 1: DEFINE MOST APPROPRIATE TEST AREA

THIS TASK AND ALL SUB TASKS ARE COMPLETE

TASK 2 DRILL AND CORE TEST WELL

THIS TASK AND ALL SUB TASKS ARE COMPLETE

TASK 3: DEFINE, CONDUCT & EVALUATE LAB TESTS

- *DEFINE SUITE OF LAB TESTS* *Sub task completed.*
- *REVIEW NORTH BURBANK UNIT FIELD CHARACTERISTICS* *Sub task completed.*
- *REVIEW OF LITERATURE* *Sub task completed.*
- *ANALYZE THE OFFSET CORE* *Sub task completed.*
- *ANALYZE THE PILOT TEST AREA CORE*

Phillips has conducted standard porosity, permeability and saturation tests on plugs taken throughout the length of the recovered core. The detail of this work can be found in Appendix A. The results are as anticipated, the layers which have the better reservoir properties has the lowest remaining residual oil saturations. There are stringers, which still have higher oil saturations indicative of little change with waterflooding, these sections are the lower porosity and permeability sections. This corresponds to the preliminary log evaluation reported by Richard Langston, consulting geologist for Calumet Oil Company, please refer to 5th Quarterly Report Appendix B, for Mr. Langston's report.

- *EVALUATE LAB TEST RESULTS FOR FREQUENCY AND AMPLITUDE*

Then Phillips will conduct sonic core studies to determine the frequencies, which effect the fluid flow through the core. While Phillips has conducted several sonic core tests on "old"

Burbank cores, the plan to perform sonic core tests on fresh cores is still integral to the project. Phillips has taken the core from Well 111-W-27 to Phillip's core laboratory in Bartlesville Oklahoma.

THE FOLLOWING TWO SUB TASKS HAVE NOT YET BEEN COMPLETED

- *MEET TO REVIEW LAB TEST RESULTS & BRACKET FIELD TEST FREQUENCIES/AMPLITUDES*
- *REPORT TO OSAGE TRIBAL REPRESENTATIVES ON PROJECT PROGRESS*

TASK 4: DESIGN AND CONSTRUCT DOWN HOLE VIBRATION TOOL AND SURFACE POWER SOURCE

- *SELECT MOST APPROPRIATE POWER SOURCE* — *Sub task completed*
- *CONSTRUCT TOOL(S) & SOURCES* — *Sub task completed.*
- *SURFACE TEST TOOLS*

The surface testing of the field test tool in conjunction with the power source life testing will be done at the Wynona Waterflood Unit, just outside Wynona Oklahoma. The well, which will be used, is Wynona Waterflood Unit Well #12-20

- *CONDUCT POWER SOURCE LIFE TEST*

The surface test is being combined with the power source test, which will enable the testing of both the variable speed drive, rod rotating system along with the Downhole Vibration Tool (DHVT). The DHVT is instrumented to measure temperature and movement. This data will be brought to the surface using an electrical cable supported by attaching it to the tubing. The downhole data and surface operating data will be recorded with a data acquisition computer for alter analysis.

- *REPORT TO OSAGE TRIBAL REPRESENTATIVES ON PROJECT PROGRESS*

Monthly telephone conversions with Joe Hughlett, Osage Petroleum Engineer have occurred and have covered the progress of these tasks

TASK 5: INSTRUMENT TEST WELLS

- *ENGINEER SEISMIC MEASUREMENT SYSTEM*

Ernie Majors from Lawrence Berkley National Laboratory (LBNL), has been consulted to assist the project in setting up the vibration detection tools and testing protocol. LBNL equipment and personnel will used to obtain and evaluate the downhole monitoring data.

- *SPECIFY SEISMIC MEASUREMENT SYSTEM*

OGCI has arranged for the necessary downhole telemetry equipment, coordinated the operation of the DHVT with the geophone monitoring efforts, with the support of LBNL personnel in planning their field test activities.

- *INSTALL MEASUREMENT SYSTEMS*

LBNL will deploy both surface and downhole geophones during the vibration tests to determine the strength of the vibrations from the DHVT. The surface seismic signals will be measured in frequency and amplitude in three directions of motion. LBNL will also use a three component downhole geophone run on a wire line provided by a third party service. A series of tests will be performed to record DHVT signal strength, radiation pattern, effect of heterogeneity and variability of the source, The results will be correlated with the lab tests that LANL will be performing on the core from the test hole.

Calumet has worked over the inactive wells to be worked over in the pilot test area, to prepare the necessary wells to be able to accept the listening devices provided by LBNL.

Equipment necessary to monitor the two injection wells for real time injection rate and injection pressure have been ordered and will be installed prior to beginning the vibration stimulation tests.

TASK 6: CONDUCT FIELD VIBRATION STIMULATION TESTS

Since May 2001, Calumet field personnel have been collecting both injection and prodcution well information to be able to establish a solid baseline for the wells in Section 8. Injection information is now being gathered daily rather than on the previous bi-weekly schedule. Calumet has also isolated the pilot test area wells at tank battery 118, to allow for unambiguous well test information.

Please refer to Appendix C for plots of the production rates and injection pressures and rates by well for the pilot test area section 8.

TASK 7: REPORT FIELD TEST RESULTS

WORK ON THIS TASK HAS NOT COMMENCED.

TASK 8: TECHNOLOGY TRANSFER, PUBLICIZE TEST RESULTS

- *WRITE & SUBMIT SPE PAPER ABSTRACT* *SUBTASK COMPLETED*

- *AUTHOR SPE PAPER* *SUBTASK COMPLETED*

SPE Paper 67303 “Enhanced Oil Recovery with Downhole Vibration Stimulation” was

given at the Production and Operations Symposium (POS) in Oklahoma City, OK on March 27, 2001.

Additional technical presentations made covering work done on this project.

- A technical paper abstract has been submitted for the ASME/ETCE conference (Feb 2002) Production Technology Symposium.
- A proposed technical paper for the April 2002 SPE/DOE 13th Improved Oil Recovery Symposium has been accepted.
- A presentation of SPE paper 67303 updated given at the Mid Continent Section of the SPE (Tulsa) 13th December, 2001.
- A version of the SPE Paper 67303 was published in World Oil, a Gulf Publishing Company, a trade magazine in their October 2001 issue.

- *ESTABLISH A SPE/DOE/IOR 2002 SYMPOSIUM VIBRATION ENHANCED PRODUCTION WORKSHOP*

A one-day SPE sponsored short course which is planned to cover seismic stimulation efforts around the world, will be offered at the SPE/DOE Thirteenth Symposium on Improved Oil Recovery in Tulsa, OK, April 13-17, 2002.

- *PREPARE VIBRATION ENHANCED PRODUCTION WORKSHOP*

Discussions have transpired concerning coupling a half-day workshop on vibration stimulation in conjunction with other DOE /PTTC sponsored workshops in the mid-continent region. There are no firm plans in place at this time to conduct such workshops.

WORK ON THE SUBTASKS LISTED BELOW HAS NOT COMMENCED.

- *PUBLICIZE VIBRATION ENHANCED PRODUCTION WORKSHOP - PTTC, OIPA, BIA,*
- *CONDUCT BIA, TRIBAL COUNCIL AND OSAGE COUNTY OPERATORS VIBRATION ENHANCED PRODUCTION WORKSHOP DATE TBD*
- *CONDUCT PTTC OK CITY VIBRATION STIMULATION WORKSHOP*
- *CONDUCT PTTC /U OF KANSAS VIBRATION ENHANCED PRODUCTION WORKSHOP DATE TBD*
- *AUTHOR DOE CONFERENCE PRESENTATION DATE TBD*
- *PRESENT DOE CONFERENCE PAPER DATE TBD*
- *PRESENT DOE/BIA CONFERENCE PAPER DATE TBD*

TASK 9: FINISH AND CLOSE OUT PROJECT

WORK ON THIS TASK HAS NOT COMMENCED.

Conclusions

Project Management

On August 23, 2001 a request for an extended budget to include work from Lawrence Berkeley and Las Alamos National Labs was submitted. On September 18, 2001, Keith Miles accepting the extended budget request signed amendment A002. This brings the total project budget to $1,020,500. This is with the DOE share of $675,750 and recipient share of $334,750. This will extend the budget period from November 12, 2001 to May 12, 2002.

The power source tests have revealed and unacceptable durability issue with the downhole vibration tool. Additional surface tests are planned prior to mobilizing for the North Burbank Unit field test. This has delayed the project by at least three months.

Technical Issues

A pilot test area was selected in Section 8 T26N R6E. The vibration stimulation test well location was determined to be 2560 ft FWL and 510 ft FSL of NW/4 of Section 8, T26N, R6E. The well has been drilled, cored, logged cased and cemented.

Power source tests were conducted in October 2001. The DHVT experienced a flex shaft failure due to galling on the internal rotating piece and the inside of the housing. The DHVT was repaired with a hardened sleeve placed in the housing and by reworking and hardening the rotating mass. The DHVT was tested again in December 2002. The DHVT again experienced a flexshaft failure, this time due to higher than expected torque levels. The flexshafts have been redesigned and built. At the time of writing this report, the DHVT with improved flexshafts is being successfully tested at a surface test site near Tulsa. The vibration stimulation tests should begin in the NBU in February, 2002.

Phillips has conducted the sonic testing of the recovered cores, but has not yet released the results.

Technology Transfer Activities

A proposed technical paper for the April 2002 SPE/DOE 13th Improved Oil Recovery Symposium has been accepted submitted.

A one-day SPE sponsored short course which is planned to cover seismic stimulation efforts around the world, will be offered at the SPE/DOE Thirteenth Symposium on Improved Oil Recovery in Tulsa, OK, April 13-17, 2002.

A presentation of SPE paper 67303 updated was given to the Mid Continent Section of the SPE (Tulsa) for early December 13, 2001.

A version of the SPE Paper 67303 was included in the October 2001 issue of World Oil, a Gulf Publishing Company.

Reference

None listed for this report.

Well 111-W-27

Core Analysis

Phillips Petroleum Company

Bartlesville, Oklahoma

Well 111-W-27 Core Analysis

NW/4 Sec 8-T26N-R06E Osage County, Oklahoma

Date : November 16, 2001
To : Bob Westermark
From : Dan Maloney
Subject: Status Update Burbank Core Lab Work

Bob, here is an update on the lab work to give you an impression of where I am at in the project.

ROUTINE CORE PROPERTIES

Figure 1 below includes data from routine core measurements. Brine and oil saturations represent saturations calculated for the plugs based on volumes of brine extracted and oil volumes calculated from mass balance. These values do not account for fluid volume changes as the cores were brought from the reservoir to the lab, fluids lost because of gas expansion, etc. The technician who measured permeability recorded "<0.01 mD" for cleaned samples of permeability too low to measure on his equipment. This doesn't necessarily mean that those samples were impermeable.

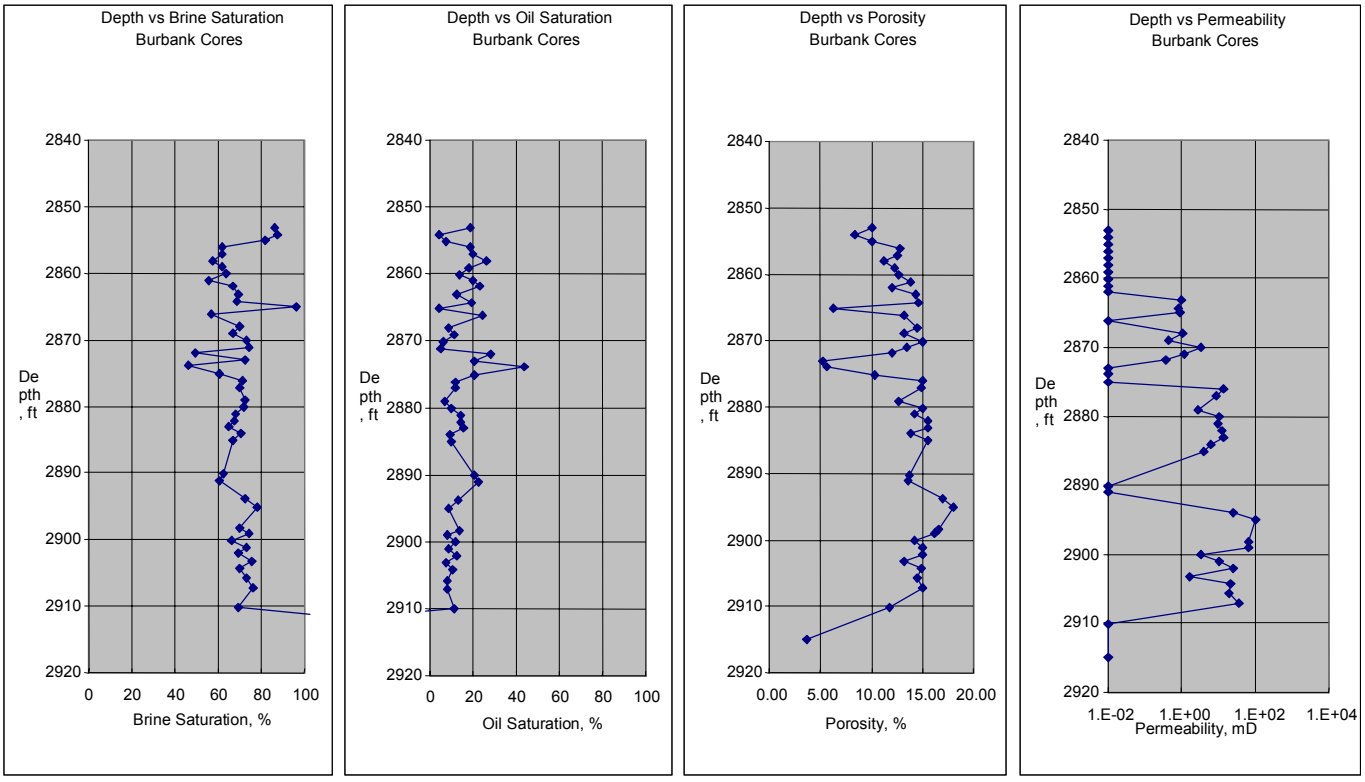


Figure 1. Routine core properties and saturations calculated from weight change and extracted water volumes.

At first glance, it appears from the data that there are 3 permeable zones within the depth column that are separated by zones of very low permeability. One might consider subdividing the data into 3 groups by depth. Figure 2 shows a plot of permeability versus porosity for each of these groups.

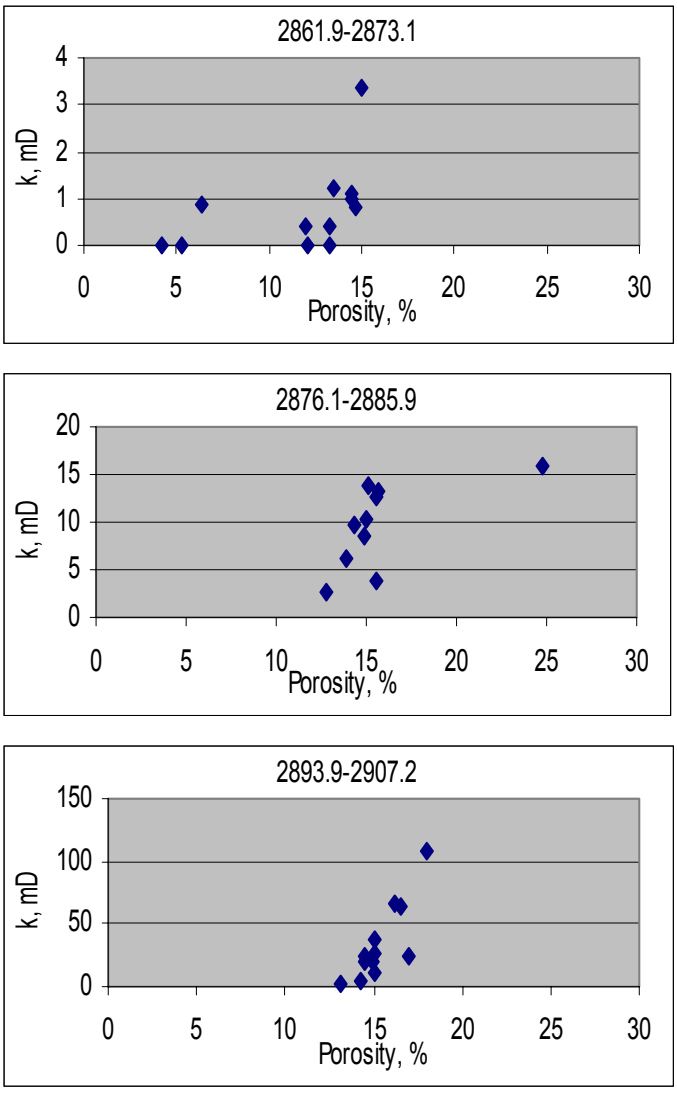


Figure 2. Permeability versus porosity within groupings by depth.

For our Sonic tests, I intend to test 2-3 samples from each of these groups. The report on the Sonic Testing should be available for the next quarterly report.

Below is a table listing the values we measured at each depth interval analyzed.

Standard Core Analysis NBU Well 111-W 27

Depth, ft	Sample	Length cm	Dia. cm	Pore Vol. cm^3	Porosity %	k, mD	Oil Sat. %	Water Sat. %
2852.08	102	6.04	3.84	3.72	5.41	0.01	N/A	N/A
2853.08	103	6.09	3.84	7.02	10.07	0.01	18.56	86.15
2854.13	104	6.36	3.83	6.15	8.37	0.01	4.48	87.75
2855.08	105	6.69	3.84	7.78	10.11	0.01	7.56	81.81
2856.1	106	5.80	3.83	8.56	12.86	0.01	19.00	61.82
2,857.13	107	6.79	3.84	9.85	12.57	0.01	20.16	62.05
2858.08	108	5.86	3.83	7.58	11.26	0.01	26.51	57.60
2859.08	109	6.45	3.84	9.09	12.25	0.01	18.26	62.16
2860.08	110	6.85	3.84	9.97	12.65	0.01	13.88	64.00
2861.08	111	5.29	3.84	8.46	13.84	0.01	20.19	55.72
2861.92	112	5.11	3.83	7.09	12.07	0.01	22.97	66.64
2863.125	113	6.66	3.83	11.05	14.41	0.99	12.68	69.51
2864.29	114	6.99	3.84	11.82	14.63	0.81	19.15	68.65
2865.08	115	6.79	3.84	4.95	6.33	0.86	4.42	96.50
2866.17	116	5.83	3.85	8.95	13.27	0.01	24.30	56.79
2867.08	117	6.35	3.84	3.06	4.19	0.01	NA	NA
2868.08	118	6.71	3.84	11.23	14.45	1.10	8.53	70.18
2869	119	5.81	3.84	8.93	13.26	0.43	11.09	66.73
2870.08	120	6.87	3.85	11.97	15.02	3.39	6.46	73.39
2871.08	121	6.81	3.85	10.61	13.45	1.20	5.19	74.56
2871.92	122	6.52	3.85	9.00	11.97	0.38	28.42	49.10
2873.08	123	6.74	3.85	4.11	5.25	0.01	20.74	72.56
2873.92	124	6.88	3.85	4.47	5.58	0.01	43.87	45.95
2875.08	125	6.65	3.85	7.97	10.34	0.01	20.32	60.56
2876.08	126	6.91	3.84	12.08	15.06	13.70	11.88	71.42
2877.08	127	6.57	3.85	11.32	14.87	8.56	11.60	69.87
2879.08	129	6.49	3.84	9.55	12.74	2.68	7.18	72.64
2880.125	200	6.56	3.84	11.36	14.98	10.24	10.01	71.87
2881.08	201	6.67	3.84	11.01	14.31	9.85	14.54	68.12
2882.125	202	6.58	3.84	11.92	15.61	12.74	14.24	67.66
2883.08	203	7.05	3.85	12.75	15.62	13.26	15.79	64.84
2884.08	204	6.81	3.84	10.92	13.85	6.15	9.46	70.53
2885.08	235	6.39	3.85	11.55	15.60	3.85	9.74	66.69
2885.9	236	7.02	3.85	20.04	24.78	15.85	10.43	40.75
2887.08	237	7.01	3.84	7.59	9.41	0.01	N/A	N/A
2888.08	238	6.73	3.85	4.44	5.70	0.01	N/A	N/A
2888.92	239	6.90	3.85	5.82	7.27	0.01	NA	NA
2890.17	240	7.22	3.85	11.52	13.78	0.01	20.53	62.39
2891.08	241	7.36	3.85	11.65	13.63	0.01	22.78	60.83
2893.19	243	7.63	3.83	3.75	4.27	0.01	NA	NA
2893.92	244	6.95	3.84	13.60	16.99	24.18	13.24	72.48
2895.08	245	7.28	3.85	15.16	17.99	107.27	8.80	77.94
2898.33	248	7.33	3.85	14.05	16.58	64.45	13.72	70.17
2899.08	249	7.65	3.85	14.39	16.23	65.37	7.99	74.22
2900.15	250	7.03	3.85	11.58	14.21	3.31	11.77	66.51
2901.1	251	6.56	3.86	11.50	15.07	10.58	9.02	72.81
2902.1	252	6.14	3.86	10.78	15.07	25.74	12.50	69.11
2903.21	253	6.35	3.86	9.74	13.17	1.58	7.54	75.93
2904.27	254	6.80	3.86	11.84	14.93	20.83	10.37	70.30
2905.77	255	7.36	3.86	12.47	14.52	20.01	8.22	73.32
2906.35	263	7.55	3.85	12.74	14.47	23.96	NA	NA
2907.17	257	5.98	3.86	10.48	15.04	36.87	8.18	76.43
2908.25	258	NA	NA	NA	NA	NA	NA	NA
2910.08	301	6.86	3.86	9.44	11.77	0.01	11.40	69.12
2914.94	302	6.81	3.86	2.95	3.71	0.01	N/A	N/A

Appendix B

POWER SOURCE FIELD TEST RESULTS

Wynona Waterflood Well 12-20

OCTOBER AND DECEMBER 2001

DHVT POWER SOURCE FIELD TEST

Purposes of test: ***To obtain operating information and determine the durability of the DHVT, in an inactive well with the tool set at a shallow depth, +/- 500'.***

TASKS TO BE PERFORMED AND EVALUATED

1. Assemble, run, set, operate and retrieve the 7" DHVT with a downhole instrumentation package and data electric line back to the surface to test its functionality and durability.
2. Assemble the rod-rotating unit, operate the 50 Hp motor using the computer to operate the variable speed motor controller, and collect data from the motor controller data acquisition system.
3. Assemble and deploy the data acquisition system for the downhole instruments, variable speed motor controller, surface accelerometers, and a single, three-axis surface geophone.
4. Collect and analyze the data generated as the DHVT is operated from data acquisition system mentioned in 3 above.

Evaluation of the Power Source Field Tests

1. Functionality: Satisfactory
   The DHVT ran and set in the well as designed, (four times at +/- 500') the retrieving mechanism has also has functioned correctly. The sucker rod on-off tool worked correctly, but initially sheared at a low over pull value, this was corrected by using a larger, stronger shear pin. The downhole instruments and electric line to the surface have operated satisfactorily. However, in the December 18th test, the soldered electrical components were shaken off the printed circuit board, indicative of excessive vibrations. These have since been repaired and, as this report is been written, are functioning properly.

   Durability: Unsatisfactory
   The durability of the DHVT have been a disappointment. At the end of the October 29th test, the tool had failed due to sever galling resulting in a broken flexshaft. The severe galling problem appears to have been over come by heat-treating the material to a much harder finish, (56 Rockwell C). Excessive torque loads have occurred causing the failures in the top flexshafts. The flexshafts have been redesigned and are currently being tested.

2. The rod-rotating unit has functioned well. The ability to control the speed of the motor with the computer has proven to be trouble free. However, the variable speed motor controller has been determined to be a major source of the electrical noise, which plagued data collection during the first days of the downhole testing, preventing

complete data collection. To minimize the motor controller's impact on the data collection system, it is being moved out of the doghouse and closer to the well for the NBU test.

3. The computer and software used for the data collection system has functioned well, considering the electrical noise problems. The flexibility of the software to adapt to changing instrumentation configurations has proven most beneficial. The data collection requirements have grown considerably since the initial plans and this computer/software combination have been able to expand to fill the needs collecting data at up to 5000 bits per second per channel. The motor controller data collection has also worked as designed.

   The surface accelerometers were added as acquisition sources when we unable to pick up signals from the geophones. These were placed on the wellhead and they verified that indeed the desired vibrations were being generated downhole and could be measured at the wellhead 500' above the DHVT.

   However, the data collected from the geophones has been problematic. With earlier field testing in 1994, we knew that the earlier version of the DHVT generated a very strong seismic signal, easily picked by geophones over 1000' away from the vibration well. Lack of seismic signals indicated either the tool was not running properly or the casing was not well cemented at the depth the DHVT was being run. Well records indicated a remedial cement job had been performed satisfactorily over the depth interval in question. The ability of the DHVT to shake the earth is predicated on good cement bonding between the casing and the formation. It became a priority at the end of the year to be able to determine if the tool operation or cement bonding was the problem. As this report is being prepared, a test site was built south Tulsa and is now being used to finish the power source testing operation.

4. Collecting the data from the downhole instruments, motor controller, surface accelerometers, and a single, three-axis surface geophone has had it's complications as described above. However the real challenge has been to develop a timely, analytical process for this newly acquired information, streaming in at very high data rates. At the surface test site south of Tulsa, we have been gathering enough data every forty minutes to fill a 650 megabit CD ROM. The preferred method of analyzing the data is to replay the data and observe the relative changes in the amplitude of the signals relative to time. This works fine sitting at a computer but producing "snapshots or stills" onto paper of moving data loses it's impact.

Planned Approach Forward

The power source field tests provided necessary operating information of the DHVT to monitor and record its performance. At the time of this report preparation, DHVT modifications have been made and are currently under test at a surface test site south of Tulsa. The preliminary results are encouraging and we plan to begin the vibration stimulation testing in February 2002 in the NBU Well 111-W-27.

Summary of Power Source Field Tests

1. The DHVT was run in the well October 19 and pulled October 29. The tool quit working after about 24 hours of operating time. Data was being recorded as the DHVT went from a normal running condition to failure in a few seconds. The mass and adjacent housing surface was severely galled. Subsequently the top flex shaft was severely bent. Please refer to figure 1 below (the top flexshaft).
2. After a failure analysis was conducted, numerous improvements were made to the DHVT, notably a hardened mass and hardened internal sleeve were added to prevent galling. Other improvements included tighter tolerances on the two bearing assemblies, added sealing attachments and tighter tolerances on the spring housing.
3. Shop tests were conducted Nov. 30 through Dec. 5, 2001 to check out the performance of the above modifications. The DHVT was running correctly. It was then readied for further power source field-testing in the Wynona well.
4. The DHVT was run Dec. 18, operated for 4 hours and pulled to check for any internal wear problems. The DHVT was good condition, but the downhole electronics package was damaged. The DHVT was re-run, without the downhole instrumentation package Dec. 20, 2001. The tool operated only thirty-seven minutes and quit working. It was pulled and inspected. There was no galling on the internal parts. The top flex shaft was slightly bent and the threads broken. Please refer to figure 1 below (the second from bottom).
5. Stronger shafts have been made and the DHVT is being re-tested on the surface as this report is being written. The preliminary results are encouraging.

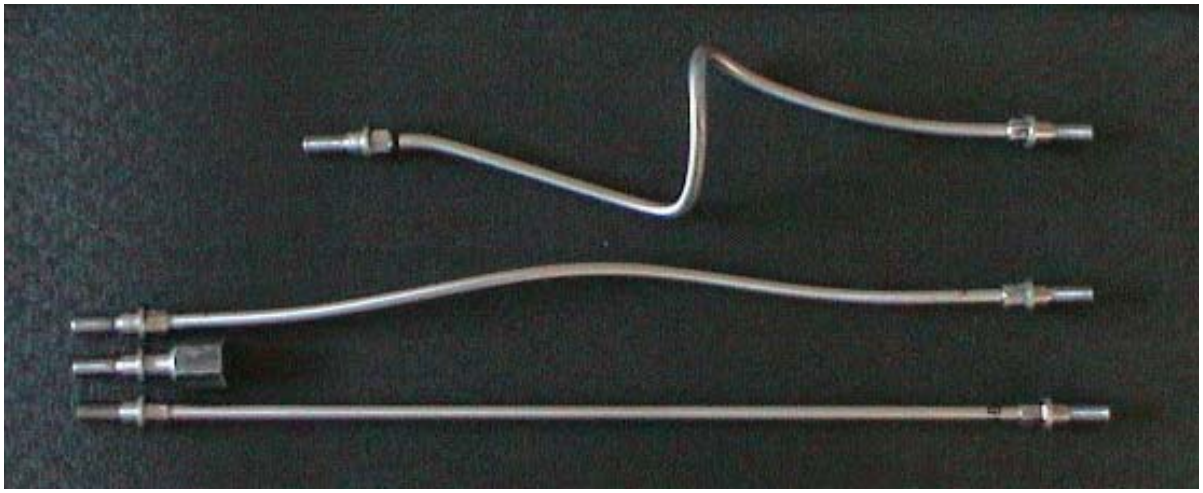


Figure 1 Bottom to top: Straight flex shaft, flex shaft thread test sample, slightly bent flex shaft, severely bent flex shaft.

Location of Well for Power Source Field Test

The power source field test was conducted in Wynona Waterflood Unit, Well 12-20. This well has been inactive since being shut-in in 1986.

Detail of Worked Performed on WWU 12-20

Aug. 10, 2001 The data acquisition doghouse and the rod-rotating unit were set at the well.

Oct. 17, 2001 A well service rig moved on the well to run a bit and scaper prior to running a packer to test the pressure integrity of the casing. The casing pressure test was okay.

Oct. 18, 2001 The 7" DHVT was run to about 500' set with 10,000 lbs. of tension on the slips. The 7/8" sucker rod on-off tool was run inside the tubing and latched onto the DHVT drive shaft. The on-off tool was sheared off the DHVT drive shaft with only 3000 lbs. overpull. The DHVT slips were released and the tool pulled from the well. The shear pin was strengthened to provide approximately 5000 lbs. overpull before shearing.

Oct. 19, 2001 Ran the 7" DHVT and set at 507'. Rigged up the rod-rotating unit. Begin rotating the sucker rods. Unable to decipher any instrumentation data due to electrical noise. Worked to reduce the electrical noise.

Oct. 22, 2001 Worked on reducing electrical noise, partially successful.

Oct. 23, 2001 Installed portable generator, electrical noise down to an acceptable level but not eliminated.

Oct. 24, 2001 Ran DHVT for approximately 4 hours and were able to obtain acceptable data from downhole instrumentation. The vibration generated were measured in the 30 to 50 Hz range.

Oct. 25, 2001 Ran DHVT for approximately 6 hours, and were able to obtain acceptable data from downhole instrumentation. Unable to detect any vibrations with the three-axis geophone at a distance of 500' northwest of the well. The vibrations generated were measured in the 30 to 50 Hz range.

Oct. 29, 2001 Ran DHVT for approximately 4 hours, and were able to obtain acceptable data from downhole instrumentation. The test today was run to duplicate the data obtain on Friday and to add hours to the run time. The downhole instrument package indicated the tool failed while running at 50 Hz. The

rig moved in and the DHVT was partially retrieved from the well when work was shut down for night.

Oct. 30, 2001 Finished pulling the DHVT from the well. Took it to the machine shop to began disassembling the tool. The rotating mass and the adjacent inside of the housing was severely galled and the upper flex shaft was severely bent and broken.

Nov 1 to Dec 15, 2001

The tool was repaired, shop tested, and readied for additional power source field-testing.

Dec. 18, 2001 Moved-in the well service rig, ran the DHVT and data cable, operated for 4 hours, and pulled the DHVT. The tool operated as anticipated, however the downhole electronics quit working after about 37 minutes of run time today. Unable to obtain a signal with the three-axis geophone, this time placed about 600' east of the well.

Dec. 19, 2001 The DHVT was disassembled and was in good condition. However the downhole electronics package was damaged beyond repair. The tool was re-assembled without the electronics package.

Dec. 20, 2001 Ran the DHVT and tried to operate the tool for about 1 hour, but it was not operating correctly. Pulled the DHVT. The upper flexshaft was slightly bent and the threads broken. There was no galling inside the tool.

DHVT SURFACE POWER SOURCE TEST RUN TIME

Date	Duration (hrs)	Cumulative Time	RPM
October 19, 2001	2.0	2	0 to 60
October 23, 2001	2.0	4	0 to 250
October 24, 2001	7.5	11.5	0 to 250
October 25, 2001	8.5	20	0 to 350
October 29, 2001	4.0	24	0 to 350
December 18, 2001	4.0	28	0 to 400
December 20, 2001	0.6	28.6	0 to 400

Appendix C

Vibration Stimulation Pilot Test Area

Production and Injection Plots

For
Section 8 26N-6E
Osage County, Oklahoma

Data Provided by Calumet Oil Company
Data Plotted by Bob Westermark

North Burbank Unit Section 8
Vibration Stimulation Pilot Test Area
Combined Production and Injection Well Daily Rates