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Integrated Approach Towards the Application of Horizontal Wells to Improve Waterflooding Performance

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Objectives

The overall purpose of the proposed project is to improve secondary recovery performance of a marginal oil field through the use of a horizontal injection well. The location and direction of the well will be selected based on the detailed reservoir description using integrated approach. We expect that 2 to 5 % of original oil in place will be recovered using this method. This should extend the life of the reservoir by at least 10 years.

To accomplish the goals of the project, it is divided into two stages. In Stage I, we will select part of the Glenn Pool field (William B. Self Unit), and collect additional reservoir data by conducting cross bore hole tomography surveys and formation microscanner logs through newly drilled well. In addition, we will also utilize analogous outcrop data. By combining the state of the art data with conventional core and log data, we will develop a detailed reservoir description based on integrated approach. After conducting extensive reservoir simulation studies, we will select a location and direction of a horizontal injection well. The well will be drilled based on optimized design, and the field performance will be monitored for at least six months. If the performance is encouraging, we will enter into second budget period of the project.

If continued, the second budget period of the project will involve selection of part of the same reservoir (Berryhill Unit - Tract 7), development of reservoir description using only conventional data, simulation of flow performance using developed reservoir description, selection of a location and direction of a horizontal injection well, and implementation of the well followed by monitoring of reservoir performance.

By comparing the results of two budget periods, we will be able to evaluate the utility of collecting additional data using state-of-the-art technology. In addition, we will also be able to evaluate the application of horizontal wells in improving secondary recovery performance of marginal oil fields.

A successful completion of this project will provide new means of extending the life of marginal oil fields using easily available technology. It will also present a methodology to integrate various qualities and quantities of measured data to develop a detailed reservoir description.

Summary of Technical Progress

During this quarter, the technical progress is limited due to contractual problems associated with signing of the contracts with the subcontractors. We have completed signing of the contracts with two of the subcontractors, Amoco Production Company and Joshi Technologies International. We expect to have the third subcontract with Uplands Resources signed before the end of this month. Once all the contracts are signed, the project will pick up the speed and progress according to the plans.

In the mean time, we are concentrating on detailed geological and engineering analysis of the available data from the William B. Self unit. We have, so far, collected all the available core and the log data from the existing as well as plugged wells. Figure 1 shows the present well locations in the unit. Based on the log and the core analysis, we have prepared the geological, facies biased, maps. These maps indicate that the Self unit can be described in terms of three subunits, A, B and C. The maps of these three subunits are shown in Figure 2.

In addition to preparing the geological map, we have also constructed the history of the Self unit based on the available data from the AAPG log library. The Glenn Pool field was discovered in 1905. The first well in the Self unit is estimated to be discovered in the year 1907. Based on the information presently available, the unit was produced using primary recovery till 1946 when the gas re pressurization began. The production continued with gas re pressurization till 1956 when the first pilot water flooding project was initiated. The water flooding was expanded to the entire unit in 1967. In 1978, ARCO Oil and Gas Co. redrilled the entire unit with new wells with an intention to flood the Unit A of the sand. The field is currently producing essentially under the same conditions as started by ARCO except that the water injection in the unit is presently restricted to recycled, produced water. Table 1 presents the brief history of the field. Figure 3 presents the production data from the unit from the point of inception. The cursory view of this figure clearly indicates a clear relationship between additional injection of water with the additional production. Based on the preliminary calculations, approximately only 22 % of the original oil in place has been recovered so far.

Tracer Studies

The first phase of the project involves drilling of a test well so as to conduct cross bore hole tomography survey as well as to make FMS measurements at the new well. We need to ensure that the newly drilled well is located as close as possible to an area where the horizontal well will be drilled. To ensure that we select a proper location of a test well, we intend to verify the geological model presented in the Figure 2. We intend to conduct two tracer tests. Test 1 will involve injecting tracer through well # 59 and observing the tracer response in wells # 64, # 54 and # 63. This will allow us to confirm the connectivity for sand A within a macro unit as well as outside the macro unit. Test 2 involves injecting in well # 74 and observing in # 71, # 77 and # 78. This will allow us to confirm the connectivity for sand C within as well as outside macro units. We have already contacted Tretolite Co. for providing the appropriate tracer. We will begin the tracer studies by the end of April.

Figure 1: Well Location Map

CONTOUR MAP FOR SAND A

CONTOUR MAP FOR SAND B

CONTOUR MAP FOR SAND C

Table 1: Historical Well Information

Year	No.of Producers	Gas Injectors	Water Injectors	Plugged	Drilled
1907	14	-	-	-	-
1915	14	-	-	5 (3,5,11,12,4)	5 (15,16,17,18,19)
1920	14	-	-	2 (17-18)	2 (20-21)
1925	14	-	-	1 (19)	1 (22)
1936	18	-	-	1 (24)	5 (23-27)
1946	16	4 (21, 28, 31, 32)	-	-	5 (29-33)
1947	19	5 (21,28,31,32,37)	-	-	6 (34-39)
1948	25	6 (21,28,31,32,37, 43)	-	-	6(40-45)
1950	27	7 (21,28,31,32, 37, 43,47)	-	-	-
1954	27	7 (21,28,31,32,37, 43)	3 (22,48,49)	-	2 (48, 49)
1957	28	-	10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	-	1 (50)
1966	28	-	10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	3 (1, 7, 8)	2 (51, 52)
1971	27(1st1/2) 24(2nd1/2)		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	4(2, 9, 10, 13)	-
1972	20		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	4(14-16, 20)	-
1973	20(1st1/2) 18(2nd1/2)		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	2 (23, 25)	

1974	17		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	1 (26)	
1977	16		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	1 (29)	
1979	6(1st1/2)		10(21, 22, 28, 31, 32, 37, 43, 47, 49, 50)	10(33-36, 38-42, 44)	3(53-55)
1980(June)	5		1 (50)	Inj. 9 Producer 3(45, 46 51)	
1981(dec)	21		10(52, 53, 58, 59, 65, 66, 67, 73-75)		
1982	21		10(52, 53, 58, 59, 65, 66, 67, 73-75)	1(6)	1 (80)
1984	20		11(52, 53, 58, 59, 65, 66, 67, 73- 75,81	1 (30)	1 (81)
1992			Same Status		

Figure 3: PRODUCTION HISTORY OF SELF UNIT

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