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FEASIBILITY OF OPTIMIZING RECOVERY AND RESERVES FROM A
MATURE AND GEOLOGICAL COMPLEX MULTIPLE TURBIDITE OFFSHORE
CALIFORNIA RESERVOIR THROUGH THE DRILLING AND COMPLETION
OF A TRILATERAL HORIZONTAL WELL

Quarterly Technical Progress Report
January 1, 1997-March 31, 1997

By
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Pacific Operators Offshore, Inc.
Santa Barbara, California

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Feasibility of Optimizing Recovery and Reserves from a Mature and Geological Complex
Multiple Turbidite Offshore California Reservoir Through the Drilling and Completion of a
Trilateral Horizontal Well

By
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**FEASIBILITY OF OPTIMIZING RECOVERY AND RESERVES FROM A MATURE
AND GEOLOGICAL COMPLEX MULTIPLE TURBIDITE OFFSHORE CALIFORNIA
RESERVOIR THROUGH THE DRILLING AND COMPLETION OF A TRILATERAL
HORIZONTAL WELL**

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C0-Participants: University of Southern California/ Coombs and Associates

Contracting Officer's Representative: Edith Allison

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Objectives

The main objective of this project is to devise an effective redevelopment strategy to combat producibility problems related to the Repetto turbidite sequences of the Carpinteria Field. The lack of adequate reservoir characterization, high-water cut production, and scaling problems have in the past contributed to the field's low productivity.

To improve productivity and enhance recoverable reserves, the following specific goals are proposed:

- Develop an integrated database of all existing data from work done by the former ownership group.
- Expand reservoir drainage and reduce sand problems through horizontal well drilling and completion.
- Operate and validate reservoirs' conceptual model by incorporating new data from the proposed trilateral well.
- Transfer methodologies employed in geologic modeling and drilling multilateral wells to other operators with similar reservoirs.

Summary of Technical Progress

Since the last progress report (October-December, 1996) additional work has been completed in interpretive aspects of the database, Well log Data (task 1.1.2), stratigraphy and micro lamination (task 1.2.1) and analysis of reservoir performance (task 1.2.2). Additional work from pressure/fluid measurements and production analysis has resulted in identification of small fault blocks not apparent by any other method.

Task 1.1.2 - Database: Well Log Data

During the previous quarter geological and petrophysical efforts were focused on identification of

layers in the subthrust portion of the field, and the integration of oil/water contacts into the geological model.

Oil water contacts previously identified are being upgraded by the addition of new markers and picks in the lower "G" sands in the supra-thrust reservoirs.

Task 1.2.1 - Stratigraphy and Micro lamination

A geologic model of 29 reservoirs along with the Hobson thrust fault and five normal faults has been constructed using a 3-D geological modeling package. The distribution of log calculated attributes as well as modeling the sub-thrust sands is in progress.

Additional fault verification work continues to be an ongoing effort. This is being accomplished by mapping the oil water contacts in each reservoir. This effort has lead to the relocation of some existing faults (some of the five normal faults mentioned above) and the discovery of some additional faults. This work is being used to find additional, but previously overlooked, fault intersections with the wellbores. Depending on the direction of fault movement, horizontal, vertical or a combination of both, indications are that hydraulic isolation of some layers could occur with little or no vertical offset or displacement on a log, with interruption of the depositional sequence.

Task 1.2.2 - Reservoir Performance

Volumetric Calculation of Original Oil in Place

The areal extent of the productive layers (supra thrust, sand C to G5) for lease P-0166 has been identified using the 3-D geologic model. Reserve determination of the productive areas in sands G6, G7 and the subthrust sands is currently in progress. Also, the evaluation of reservoir attributes in the subthrust sands is in progress. In the current effort, for the sake of completeness, previous reservoir data have been used to complete the estimation of OOIP for lease P-0166. The calculations will be revised when refined reservoir attributes and net pay volumes are updated. Net average thickness and thickness weighted average porosity and water saturation of each sand are used in the estimation of OOIP. An average oil formation volume factor of 1.15 bbl/STB is used in the volumetric calculations. The original oil in place for lease P-0166 by layer is given in Table 1.

Production Allocation

A production allocation model developed in the prior budget period was modified during this period in an attempt to more accurately predict the oil and gas produced from the 29 layer comingled system. Productive areas for individual sands with pertinent effective average porosity and water saturation and net pay thickness were used to calculate the original oil in place and the remaining oil at the end of each timestep. Table 2 shows a comparison between the allocation results with TDT log analysis for wells B-5A, B-8 and B-46 conducted by the previous lease operator in 1982. Table 3 shows a comparison of the model results with a flow test by zone on well B-37 in 1980. As can be seen there is a good agreement between the field and the model results. Further improvements may be achieved by recognition of the exact boundaries of the fault blocks. The model will be revised when the ongoing study of fault blocks is complete. Further, while not in the scope of the

Class III project, the zone by zone, well by well, allocation results are being supplied to another study effort that is employing 3-D reservoir simulation.

Reservoir Description

The West Hogan normal fault determined by geological study is further confirmed by production analysis of Wells A-23 and A-26. These two wells both are opened to F-1, G-1 to G-3. A-26 is located up structure with respect to A-23 but its producing GOR is one half of that in Well A-23. Further data are required to analyze the discontinuity of sands F-1, G-1 to G-3 in that region.

Analysis of recent static pressure (fluid level measurements) on shut-in wells A-43, A-44, A-47 and A-48 shows that wells A-43 and A-44 both have the similar bottom hole pressures which are greater than the BHP of well A-48 by 420 psi. This indicates that well A-44 and A-48 may be in two separate fault blocks. Currently, some bottom hole static pressure measurements are being taken in the field which will further verify the existence of some of these postulated faults.

Identification of the probable source for the water production is continuing. No new measurements are currently available, however additional measurements are contemplated so that a comparison of the production and mechanical histories can be used to estimate the most probable source or water in these commingled completions. Few wells had isolated production from which to draw accurate layer oriented characteristics. About one quarter of the wells were drilled during an infill program which provided some input to the depletion study. New saturation logs are necessary to investigate the source of water production.

1.3.1 Management and Administration

Monthly meetings were held with the participants in the project (USC, Coombs and Associates) to review the progress of various tasks.

1.4.1 Tech Transfer

During this period we completed the following activities:

- Sponsored the PTTC West Coast Workshop on "California Geology With and Without Computer Graphics" on Jan. 15, 1997. We also presented a paper on the geological modeling of the Carpinteria field.
- Attended the DOE Reservoir Characterization Conference and participated in the discussion regarding geological modeling.
- Sponsored a field trip for 19 students from University of Southern California who visited the offshore platforms.
- Sponsored a field trip for 6 students from University of California Santa Barbara who visited the offshore platforms.

- Sponsored a field trip for 2 students from California State College at Northridge who visited the offshore platforms.

TABLE 1
Original Oil in Place for Lease P-0166 by Volumetric Method

Sand	Productive area acres	Net thickness ft.	Ave. ϕ	Ave. Sw	OOIP, MSTB
C1	0.00	3.64	0.2920	0.5003	0
D1A	47.83	8.83	0.2403	0.4965	345
E1	281.28	37.87	0.2642	0.3754	11,857
E1A	207.85	31.16	0.2585	0.4462	6,255
E2	13.31	7.14	0.2293	0.5189	71
E3	3.66	2.59	0.2583	0.5206	8
E4	63.04	13.06	0.2715	0.4942	763
F1	475.24	116.45	0.2263	0.3681	53,387
F2	220.14	33.62	0.2348	0.4514	6,431
F2A	108.39	18.77	0.2110	0.4979	1,454
F3	255.25	30.33	0.2093	0.4465	6,049
F4	268.56	33.00	0.2157	0.4115	7,589
F5	111.17	18.06	0.2198	0.4662	1,589
F6	69.33	13.32	0.2098	0.5053	647
G1	253.64	44.53	0.2190	0.3445	10,938
G1B	176.55	23.37	0.2109	0.3320	3,921
G2	281.28	13.05	0.2055	0.3900	3,103
G3	238.00	68.76	0.2155	0.3361	15,794
G3A	119.40	10.94	0.2067	0.4581	987
G3B	88.93	23.57	0.2251	0.3501	2,069
G4	98.59	7.79	0.2010	0.4502	572
G5	75.62	6.49	0.1818	0.5111	294
G5A	67.72	9.53	0.2084	0.4668	484
G5B	31.60	5.16	0.2053	0.5325	106
G5C	22.53	3.24	0.1957	0.5369	45
G6	23.70	11.99	0.2077	0.4767	208
G6A	29.20	4.58	0.2080	0.4955	95
G6B	44.90	16.50	0.1989	0.4563	541
G6C	35.50	4.64	0.1819	0.4697	107
G7	87.50	20.45	0.1907	0.4211	1,332
ST	558.00	43.00	0.2100	0.4200	19,715
Total OOIP, MSTB					

TABLE 2
Comparison Of Allocation Program Results With TDT Log Analysis
Average Oil Saturation in Percent

ZON E	WELL B-5A			WELL B-8			WELL B-46		
	TDT LOG ANALYSIS 9-30-1982		ALLOC. 9-30-1982	TDT LOG ANALYSIS 9-30-1982		ALLOC. 9-30-1982	TDT LOG ANALYSIS 9-30-1982		ALLOC. 9-30-1982
	RANGE	AVE. S _o	AVE. S _o	RANGE	AVE. S _o	AVE. S _o	RANGE	AVE. S _o	AVE. S _o
F-1	18-60	42	49	20-90	45	51	-	-	50
F-2	-	-	-	25-55	38	47	-	-	-
F-4	20-50	35	47	25-60	40	47	20-70	50	53
G-1	25-60	43	46	10-38	25	44	30-60	45	-
G-1B	20-45	30	49	15-40	25	52	25-60	48	55
G-3	20-60	42	43	15-62	38	46	30-60	45	-
G-3B	40-70	55	43	20-45	38	47	35-55	45	52

TABLE 3
COMPARISON OF ALLOCATION PROGRAM RESULTS WITH FLOW TESTS BY ZONE
WELL B-37

ZONE	FLOW TEST 12/7-20/1979	ALLOCATION RESULTS JAN, 1980
E	-	4.9 %
F	38.4 %	32.1 %
G	26.5 %	22.6 %
SUBTHRUST	35.1 %	40.4 %