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Optimizing Reservoir Management In Developed Fields: A Case Study XYZ Integrated Fields

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ABSTRACT
Optimal economic exploitation of a reservoir throughout its entire life span requires Sound reservoir management practices based on the utilization of available professional, technological, and Economical resources. XYZ oil and gas field was subjected to all round investigation and to go conduct a reservoir optimization study of its largest operated fields, in the Niger Delta was efficiently reviewed, consequently, a broad review of the field's four largest reservoirs in two phases were investigated and to evaluate and recommend the economic potential of the best optimal reservoir practices for optimal hydrocarbon recovery of original oil in place, for future economic analysis and improve recovery of reserves at minimum production and economic cost.
Keywords: Reservoir, optimally, Original oil in place , Field , Recovery , Abandonment and Workover

INTRODUCTION

Integrated reservoir management has received significant attention in recent years. The need to enhance recovery from the vast amount of remaining oil- and gas-in-place plus the global competition requires better reservoir management practices. Basically, sound reservoir management practice relies on the utilization of available field professional, technological, and financial resources to maximize profits from a reservoir by optimizing recovery while minimizing capital investments and operating expenses
(Odu, 2010) Economically successful operation of a reservoir throughout its entire life, beginning with exploration leading to discovery, followed by delineation of the reservoir, development of the field, , and, finally, to initial and final abandonment (Brown and Skipsy, 2005) requires:
1. **Synergy** - multidisciplinary professionals working as a well-coordinated team.
2. **Integration** - merging people, technology tools and data across organizations, across disciplines, and across the world and among professionals in related field.
3. **Support** - company culture and organization removing barriers and fostering team work and integration for maximum output (Akpoturi, 2011)
A comprehensive reservoir optimization study of its largest operated field XYZ of an integrated team of geoscientists and engineers from top Nigerian oil and gas operators was charged to review the field's four largest reservoirs in two phases to evaluate and capture the upside potential of the reservoirs.

METHODOLOGY

a. Challenges

The field under review is located in the Niger Delta, about 15 kilometers offshore Nigeria, was discovered in 1973. Sixty-four wells, including 58 commercial wells, were drilled as of June 30, 1995. Production has been obtained from 6 major sands out of 12 sand reservoirs at depths between 4,900 ftss 7,100 Irri-5, Irri-7, Irri-3 and Irri-4 reservoirs in the field contain most of the combined field reserves. Basic data on the petrophysical properties of the reservoirs are given in
Table 1.

The studies had to deal with the following challenges:
1. Mature and developed reservoirs
2. Declining production
3. Increasing operating costs
4. Unrealistically high current recovery factors
5. Need to enhance economic viability of the study
6. Integration across disciplines and organizations

b. Objectives

The objectives of the studies were to determine:
1. Ultimate primary recoveries
2. Effects of additional vertical and horizontal drilling and workovers, including gas lift, to optimize recovery
3. EOR potential

The approach taken was to:
1. Review geoscience and engineering data
2. Build a geoscience-engineering model for each reservoir
3. Perform classical material balance analysis
4. Make simulation studies
   - reservoir description
   - history matching
   -full-field performance prediction
5. Plan strategies and forecast performance
   - under existing conditions
   - with workovers and infill wells
   - with gas lift
   - with water injection

The studies utilized integration/alliance of organizations data professionals working together as a team (Table 2), tools and technologies Multidisciplinary data used and their sources are listed in Table 3, Integrated geoscience and engineering reservoir models were developed using revised maps based on "based on the re-processing and re-information of the 3-D seismic data acquired in 1986 along with well log and core analysis data, rock and fluid properties, well test data, and other engineering data and twenty years of field production history.

Integrated Petroleum WorkBench software, which consists of reservoir description, well test analysis, production data analysis, and black oil simulation modules, was utilized for fill-field performance history match and forecasts. The stepwise history matching procedure consisted of pressure matching followed by saturation matching. Pressure matching was achieved by specifying oil gas and water production for the wells while adjusting pore volumes, aquifer strength, and fault connections.

3-D seismic survey data were re-examined for validating the reservoir models. Pressure matching ensured that the reservoirs' historical total (three-phase) voidages were duplicated both for the total reservoir and for each well.

Saturation matching, which was achieved by adjusting gas-oil, and water-oil relative permeability curves, ensured that the correct historical volumes of gas and water duplicated in terms of gas-oil and water-oil ratios.

Computed Work bench results were imported into 3-0 visualizer (REVIEW) for more comprehensive viewing of the results.

Deliverables

The expected deliverables are listed below:
1. Improved reservoir description
2. Updated original oil in place
3. Reserves additions

4. Better reservoir management skills and practices.
5. Technology transfer/application

RESULTS AND FINDINGS

The original oil-in-place values estimated from classical material balance analyses and simulation techniques are comparable to each other but are substantially higher than the previous estimates (see Table 4). The material balance showed that the primary production mechanism of the Irri-5, Irri-7 and Ala-5 sands is strong water drive, with additional support from gas cap drive and solution gas drive, The Ala-3 reservoir demonstrates weak water drive plus gas cap drive and solution gas drive.

After reservoir performance history matching using the black oil simulator in Work Bench, model prediction runs were made under various investment scenarios for optimally draining the reservoirs. They include additional take points, horizontal wells gas lift and water injection. Opportunities were identified for performing workovers and placing additional wells to improve drainage in the well operation of the selected fields.

Performance forecasts for the remaining period of the investigation were made under different operating scenarios in order to determine the optimum development plan as follows:

Case I: Primary depletion with the current wells and production limitations (Base case)
Case 2: Base Case - Infill Wells + Workovers
Case 3: Case 2 + Gas lift
Case 4: Case 3 + Water Injection (applicable to Ala-3 sand only)

Since the Ala-3 reservoir has weak natural water drive, the studies showed that recovery could be improved with water injection. The Ewinti-5, Ewinti-7 and Ala-5 reservoirs on the other hand, have strong water drives, and thus no water injection case was needed or attempted.

The estimated reserves increases from the simulation studies are given in Table 5. The new estimated reserves are substantially more than the booked values.

RECOMMENDATIONS

Additional drilling/completion recommendations from the studies are as follows:

1. Two horizontal wells and one work over for Ewinti-5
2. One horizontal well, I deviated well and I work over for Ewinti-7
3. Two horizontal wells, 2 deviated wells and 2 work over wells for Ala-3.
4. One replacement well and I deviated well for Ala-5.

For the Irri-5 and Ala-3 reservoirs, all infill and work over wells are located in the operated field. Since the current drainage patterns in the North Apoi area are adequate, no additional off take points are necessary there.

Based on the study recommendations, and drilled two successful horizontal wells were drilled in Irri-5 reservoir. The first well is producing 2670 BPD of oil from a 700 foot horizontal section, The second well has a 1600 horizontal pay section and is currently producing 4020 BOPD (see Table 6).

CONCLUSIONS

The conclusions made from the integrated study are:

1. 3-D seismic data improved reservoir description and original oil recovery by 25%..
2. Original oil-in-place is considerably more than the booked values, and reserves additions are substantial and economical.
3. Significant value has been added to XYZ field's assets as a result of team work and a multidisciplinary approach to evaluating the reservoirs and optimizing the scenarios for reservoir management as an efficient tool for improve oil recovery.
4. Team work and integration of professionals, data, technology, and tools were critical to the success of this study.
5. The studies set an example for effective and expeditious technology transfer and application.

REFERENCES

1. Odu, C.I (2010); quantitative assement of the sources and fate of hydrocarbon recovery in marine environment Phil. Trans Royal Soc. London 29 (B), 193-218
2. Brown, G.C and Skipsy. E (2005); Energy and technology Resources, Geology, supply and Demand. Open University Press, Milton Keynes.
3. Akpoturi, P. E (2011), Reservior Management ; key to optimal Hydrocarbon Recovery of Engineering & Environmental Studies, Vol.3, No 2, Pg 12 – 16, 2011

Table 1

Basic Reservoir Data

Depth - FTSS	5000	5300	7000	7200
Trap	Structure/Faulting	Structure/Faulting	Structure/Faulting	Structure/Faulting
Rock Type	Unconsolidated Sand	Unconsolidated Sand	Unconsolidated Sand	Unconsolidated Sand
Gross Thickness	70- 130	70- 90	60- 170	150- 200
Porosity- %	30	26 - 30	20 - 25	20 -25
Permeability- MD	1500	1000 - 2500	500 - 1500	20 - 25
Initial Pressure- PSIG	2200	2410	3000	3185
Reservoir Temperature (oF)	165	165	222	200
Initial Soln. GOR SCF/STB	364	500- 700	940	900
Initial Oil Form. Volume Factor (RB/STB)	1.2	1.23	1.6	1.3
Oil Viscosity - cp	1.5	0.9	0.5	0.4
Oil Gravity - oAPI	28	33 - 35	40	41
Gas Gravity - (Air = 1)	0.6	0.65	0.7	0.65
Drive Mechanism	Gas Cap/Strong Water Drive	Solution Gas/Water Drive	Gas Cap/Weak Water Drive	Strong Water Drive
Original Oil in Place- MMSTB	293	141	214	120
Cum. Prod. 12/94- MMSTB	85	38	47	47

Table 2

Team Members

TOPCON

- **Engineers - 3**

Geologist - 1

DPR and NAPIMS

- **Engineers - 2**

Texaco EPTD Specialists

- **Computer Support - 1**
- **Geophysics -1**
- **Geostatistics - 1**
- **Horizontal Wells - 2**

Petrophysics - 1
Project Management - 1
Reservor Engineering - 2
3D Visualization - 2

SSI Consultants

- **Engineer - 1**

Project Coordinator - 1

Texaco Management Support and Commitment

Table 3

Data Sources

DATA	SOURCE
Structure & Isopach Maps	3D Seismic & Well Logs
Porosity, Permeability, Fluid Saturations	Well Logs, Cores, Correlations
Fluid Contacts, Formation Tops	Well Logs
Reservoir Pressure & Temperature	Well Test
PVT Properties	Bottom Hole Sample, Correlations
Relative Permeabilities	Cores, Correlations
Production	Well Test, Allocation Summary

Table 4

Original Oil-In-Place
(MMSTB)

		CURRENT	OILWAT	SIMULATOR
Phase I	EWINTI-5	216	312	293
	ALA-3	96	253	215
	TOTAL	312	565	508
Phase II	EWINTI-7	76	146	141
	ALA-5	60	121	120
	TOTAL	136	267	261
	GRAND TOTAL	448	832	769

Table 5

Reserves Addition Summary
(MMSTB)

	Infill Drilling/ Workovers	Gas Lift	Water Injection