

Multi Lateral Horizontal Well Application to Enhance the Oil Recovery of a Mature Field, Intisar 103L Field

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1. Introduction

Intisar 103L Field is located approximately 370 km to the South of Benghazi in the Sirte Basin of Concession 103 in Libya. It was discovered in 1968 by drilling the first discovery well, L1-103 down to a total depth of 10,295 ft

The field comprises two separate carbonate reservoirs namely the Eocene Gir at a depth of -7,450 ftSS and Paleocene Upper Sabil (Zelten) at -8,500 ftSS being around 1,000 ft apart from each other. The reservoir structures are four way dipping anticlines with less than 50 ft closures. The average porosities of the reservoir units range between 15% to 28%, though the permeabilities are quite low at 1 md to 15 md. The field is relatively small in size with an initial oil in place of 19.6 MMSTB of which 14.9 MMSTB is contained in Gir and 4.7 MMSTB in Sabil.

The field was developed initially by drilling three vertical wells, L1-103, L2-103 and L3-103, from 1968 till 1975. The L3-103 well was drilled in the flanks of both closures, hence, no commercial production was established from this well. The field production was commenced in 1976 from the two productive wells L1-103 and L2-103.

The production mechanisms of the reservoirs, are established thru fluid expansion and marginal support of low permeability flank aquifers, that's why the reservoir pressures have declined by almost 2000 psi from initial 3900 psia to current 1900 psia. Due to thin reservoir sections, low reservoir permeability and lack of aquifer supports the existing two vertical well's potentials have been quite marginal with field oil production rates between 250 STB/D to 300 STB/D over the last 15 to 20 years. As of October 2005 a cumulative oil of 3.4 MMSTB was recovered from these two wells comprising a recovery factor of only 17%.

In 2003 a simulation study was conducted to define an optimum re-development plan to increase field production potential. As per the subject study, the most appropriate scenario was proposed to drill a horizontal well in the Gir reservoir and perforate the Shoal reservoir in the L2-103 to produce both reservoirs, Gir and Shoal as commingled from the well.

This paper will present a successful case study implementation of 103L Field of Zueitina Oil Company by; (1) drilling a multi lateral horizontal well, L4 and (2) re-completing the well, L2-103, as commingled in two reservoirs. As a result of this project, the oil production potential of the field was increased almost by three folds from average of 270 STB/D in 2004 to 900 STB/D in 2005. The oil reserves have been increased by 1.2 MMSTB from 4.2 MMSTB to 5.4 MMSTB until the year 2022.

A simulation model update in 2007 indicates that water injection could further increase the reserves up to 7.8 MMSTB. Zueitina Oil Company plans to implement a feasibility study for the second phase of the project to start water injection in the field

2. Key Features

- Reservoir characterization of multiple carbonate reservoirs
- Reservoir modeling and simulation study
- Application of multilateral horizontal wells in thin and tight reservoir units to improve sweep efficiency
- Water injection and dump flood sensitivity analysis for oil recovery improvement
- Methodology of commingled production
- Implementation of a case study
- Incremental production capacity and reserves recovery

3. Conclusions

The following conclusions are derived from the simulation study modeling and field case study application.

1. The field performance after implementation of the project confirmed the proper reservoir characterization and reservoir simulation model predictions.
2. Horizontal multi-lateral well application in 103L Field tight carbonate Gir reservoir has increased the production potential by three folds compared to the vertical wells.
3. Horizontal well application has increased field drainage area and improved the reservoir sweep efficiency.
4. Properly designed commingled production from multiple reservoirs might be feasible for incremental reserves. Re-completing the well L2 as commingle producer from two reservoirs has increased reserves and saved significant cost from drilling additional wells.
5. Application of improved oil recovery techniques in 103L Field has increased the field production capacity from 270 STB/D to a neighborhood of 900 STB/D and reserves from 4.2 MMSTB to 7.8 MMSTB.

4. References and Bibliography

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Speaker's Biography

Mr Abdulhakim Elghadban holds a B. Sc Degree in Petroleum Engineering from Al Fateh University, Libya (1991). Mr. Elghadban has 16 years of experience in Libyan oil industry, including seven years of field production and completion engineering activities with Waha Oil Company and Zueitina Oil Company and 9 years of reservoir engineering activities with Zueitina Oil Company. Currently he works as a reservoir engineering specialist for Zueitina Oil Company for which he has involved in reservoir management activities of major reservoirs and coordinated and conducted a number of reservoir conventional and simulation studies.