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RESERVOIR SIMULATION STUDY OF PWF (PATERN WATER FLOOD) IN M FIELD IN INDONESIA

Reservoir simulation is considered to be the most important forecasting tool available to the reservoir engineer since it considers much more geological and reservoir data than any other reservoir forecasting technique. Consequently, reservoir simulation puts forward greater data requirements than other techniques. The basic elements of any reservoir simulation study are defining the study objectives, gathering and analysing data, constructing the reservoir simulation model, history matching the simulation model, running prediction cases and reporting. Based on the simulation study, analysis and interpretation in the M Field in Indonesia, it was found that with a certain assumption, the history matching is pretty close to the real conditions. The Vertical producer with water injector gives higher oil production; slower pressure decline and pretty similar Oil Efficiency. Horizontal producer well give better oil recovery and higher Oil Efficiency in comparison with Vertical producer as well as the feasibility study indices.

Моделирование пласта-коллектора считается наиболее важным инструментом прогнозирования, доступным инженеру-разработчику нефтяных и газовых месторождений, так как оно учитывает значительно большее количество геологических данных и промысловых параметров, чем прочие технологии прогнозирования свойств коллектора. Моделирование пласта-коллектора выставляет более жесткие требования к исходным данным, чем любая другая технология. Основные элементы любого моделирования пласта-коллектора определяют цели изучения, собираемые и анализируемые данные, построение математической модели пласта-коллектора, адаптацию математической модели, проведение примерного прогнозирования и отчетности. Основываясь на моделировании пласта-коллектора, анализе и интерпретации данных по месторождению M Field в Индонезии, было обнаружено, что при определенном допущении адаптация модели значительно приближается к реальным условиям. Вертикальные водонагнетательные добывающие скважины дают более высокую нефтедобычу, более медленное падение давления и сходные показатели по эффективности. Горизонтальные добывающие скважины обеспечивают высокий коэффициент извлечения и высокие показатели эффективности по сравнению с вертикальными скважинами, а также высокие показатели технико-экономического обоснования.

Introduction

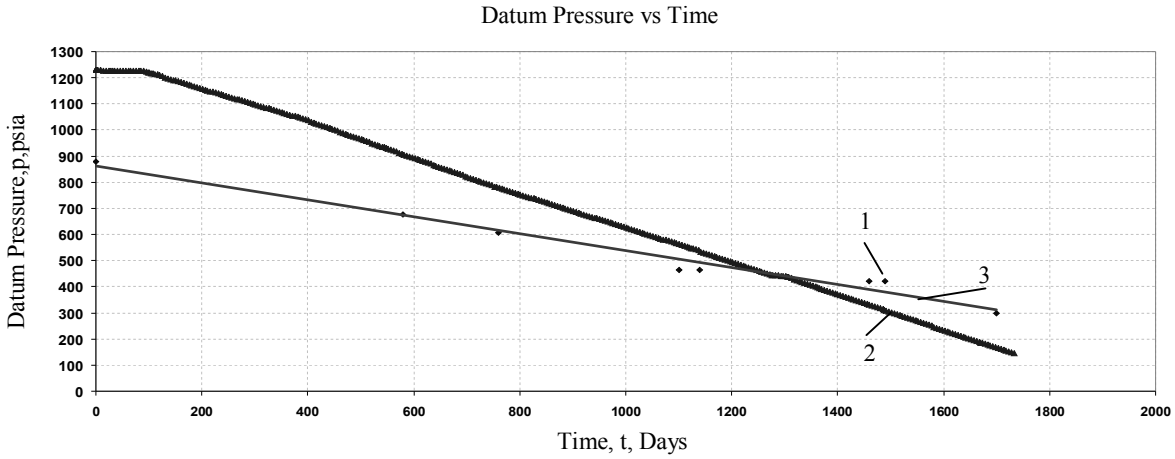
M Field is the largest water flood filed in South Asia, with current production around 100,000 BOPD, average water cut 98,5 %. This field was produced since early 1950 that operated by X in Indonesia. In mature water flood field, the production declining problem is a big challenge for the engineer. In this paper, I have doing the reservoir simulation study in this mature M Field with depletion characterizations to see the effect water influx as well as the application of horizontal well in order to see beneficial effect from both technically and economically point of view in this particular reservoir.

History Matching

To predict the better and accurate future performance as well as to present the current pressure and saturation state of the reservoir, the history matching was needed to be performed. Production and pressure data are two main components in this matter.

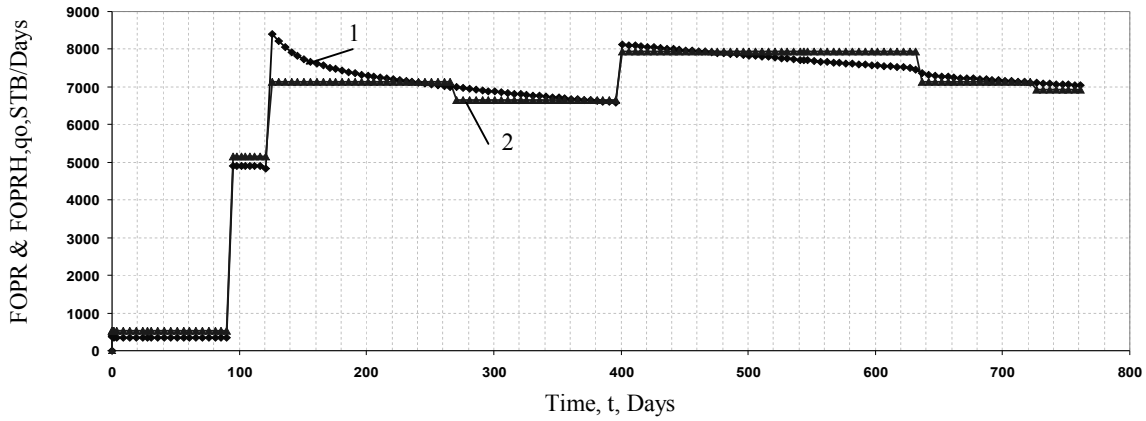
Case Analysis

Compare Case 1-Base Case: Produce with Depletion (no water Injection well) with Case 2-Case with water Injector well to see the different performance in real case (Depletion) in comparison with water injection existence.



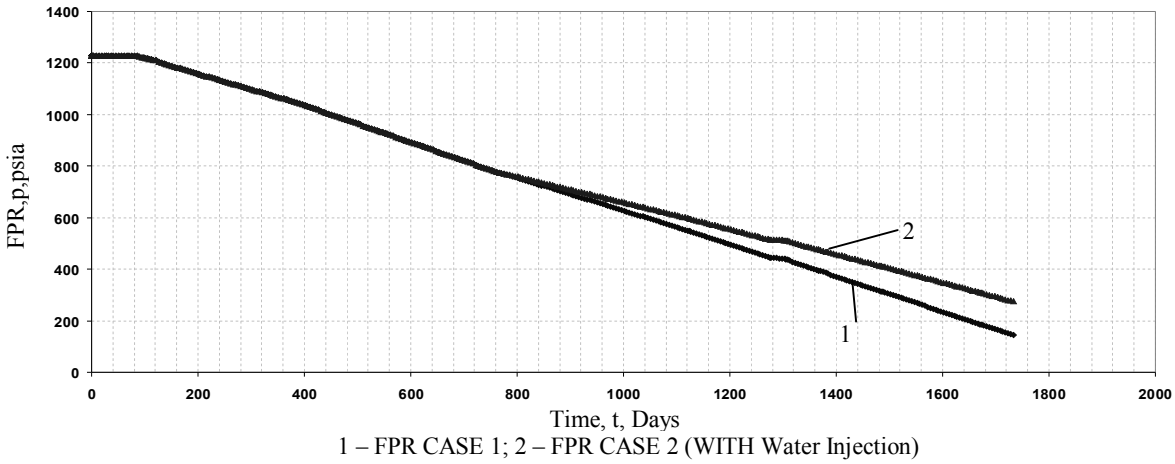
1 – Datum Pressure vs Time; 2 – FPR; 3 – Linear (Datum Pressure vs Time)

Figure 1. Pressure History Match



1 – FOPR for case 1; 2 – FOPRH for case 1

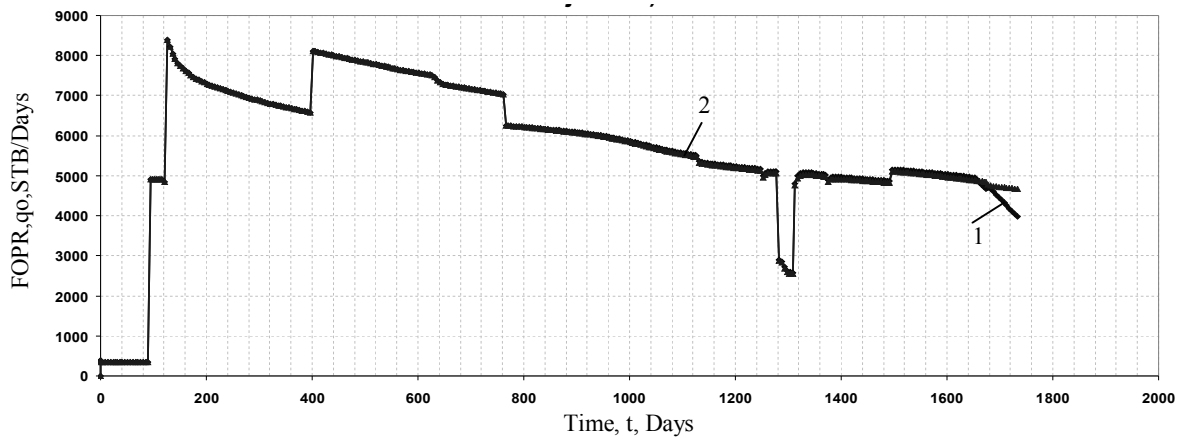
Figure 2. Oil Rate History Match



1 – FPR CASE 1; 2 – FPR CASE 2 (WITH Water Injection)

Figure 3.FPR for Case 1 & 2 (with and without Water Injection)

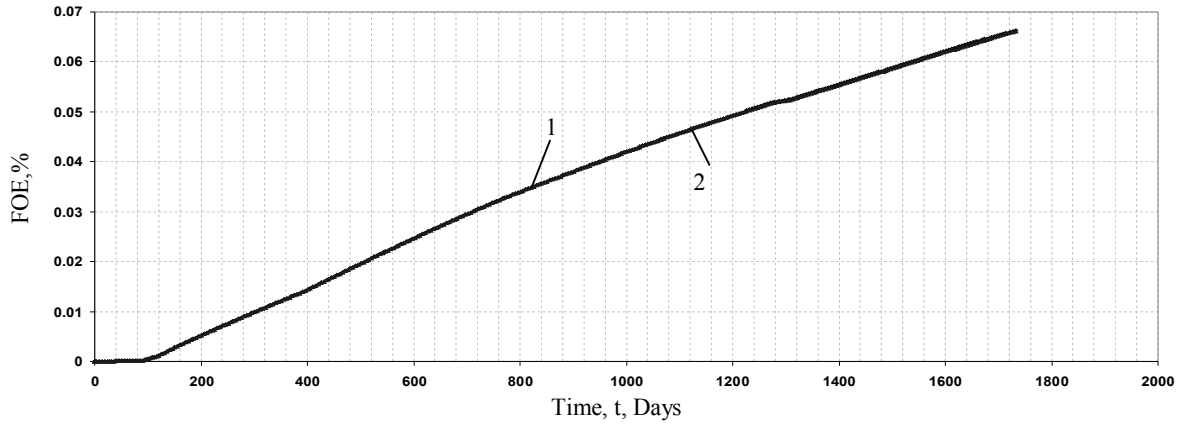
Field Oil Production Rate (FOPR) for Case 1 & 2 (with and without Water Injection)



1 – FOPR CASE 1; 2 – FOPR CASE 2 (WITH Water Injection)

Figure 4.FOPR for Case 1 & 2 (with and without Water Injection)

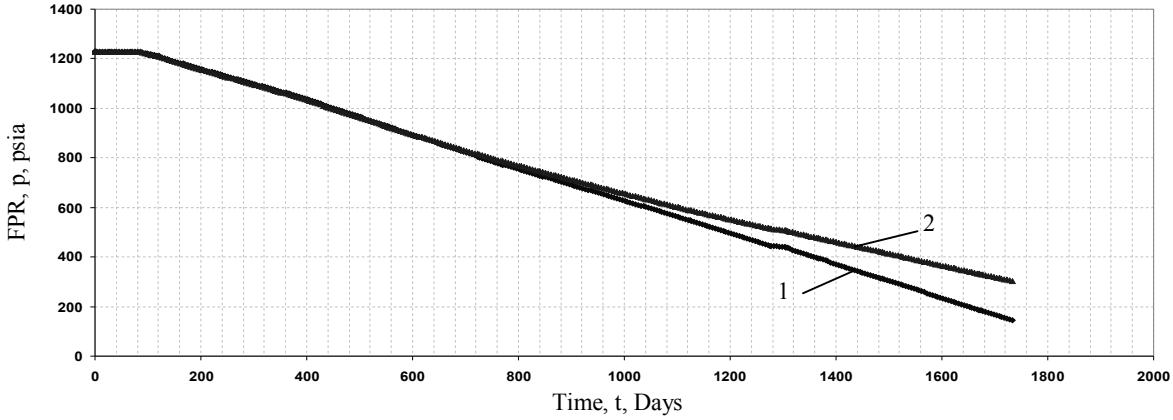
Field Oil Efficiency (FOE) for Case 1 & 2 (with and without Water Injection)



1 – FOE CASE 1; 2 – FOE CASE 2 (WITH Water Injection)

Figure 5.FOE for Case 1 & 2 (with and without Water Injection)

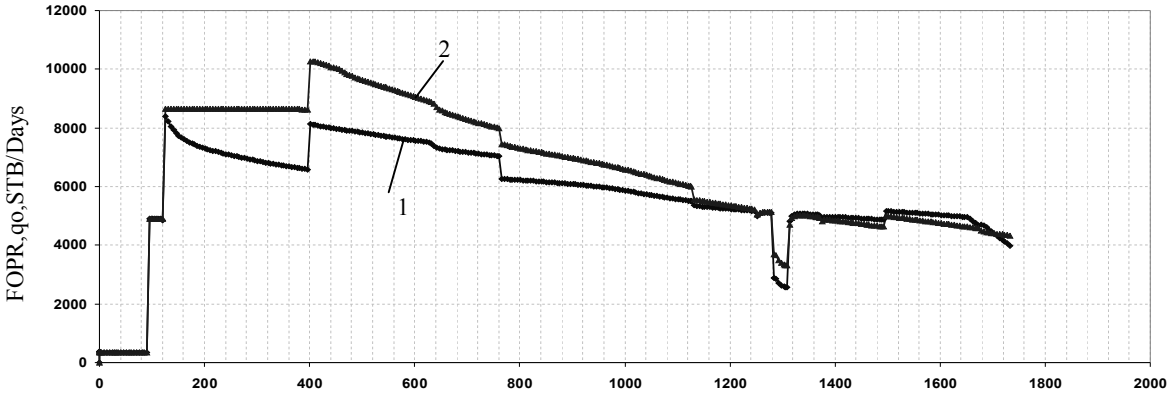
Field Pressure Rate (FPR) for Vertical & Horizontal Well



1 – FPR Vertical Well; 2 – FPR Horizontal Well

Figure 6. FPR for Sensitivity Analysis (Horizontal & Vertical Well)

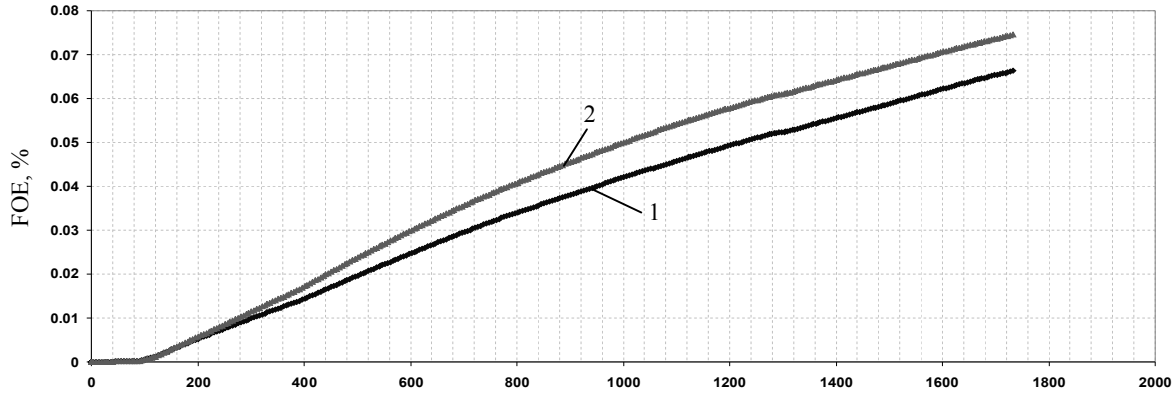
Field Oil Production Rate (FOPR) for Vertical & Horizontal Well



1 – FOPR Vertical Well; 2 – FOPR Horizontal Well

Figure 7. FOPR for Sensitivity Analysis (Horizontal & Vertical Well)

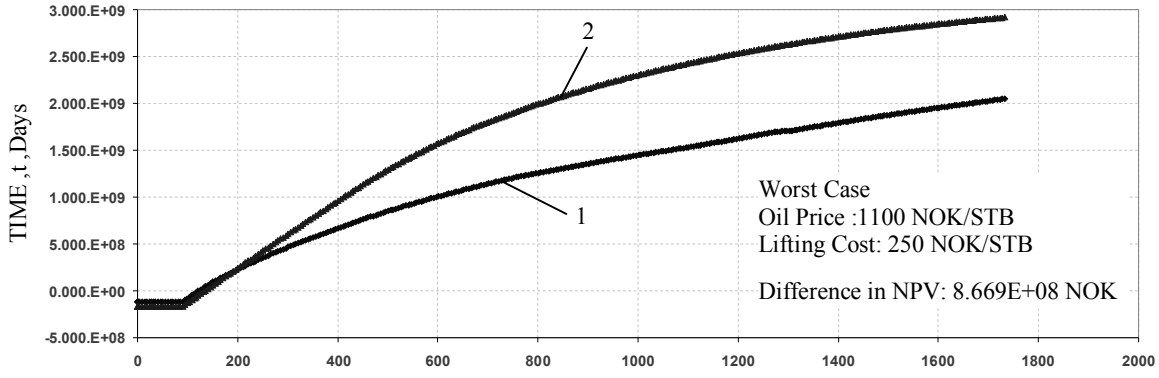
Field Oil Efficiency (FOE) for Case 1 & 2 for Vertical & Horizontal Well



1 – FOE CASE 1; 2 – FOE Horizontal

Figure 8. FOE for Sensitivity Analysis (Horizontal & Vertical Well)

INCREMENTAL NPV (VERTICAL & HORIZONTAL WELL) WORST CASE



1 – VERTICAL; 2 – HORIZONTAL

Figure 9. Incremental NPV (Horizontal Well and Vertical Well) for Worst Case

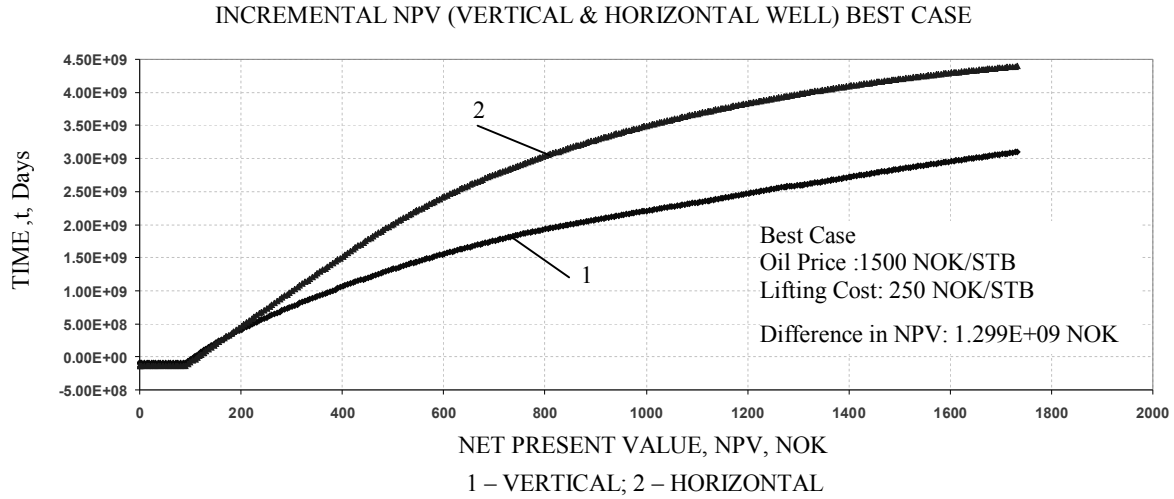


Figure 10. Incremental NPV (Horizontal Well and Vertical Well) for Best Case

Sensitivity Analysis:

Compare Analysis 1-Base Case with Analysis 2-Horizontal well, Produce with Depletion to see the different performance of different well perforation type, Horizontal well in comparison with existing Vertical well.

Preliminary Feasibility Analysis

Feasibility analysis was done using economical aspect in order to obtain the Net Present Value (NPV) for both cases with Horizontal and Vertical Well.

Conclusion

The main significant effect we might see from the short term prediction is that water injection will give water support and maintain reservoir pressure from being dramatically decreasing. Any predictions made without the presence of water injection gives lower result in oil production and efficiency and reservoir pressure goes down very quickly.

Horizontal well give better results compare with vertical well. The oil production rate yet the oil field efficiency give higher number for horizontal well, hence lower water production has obtained in result as giving in water cut trend. Postponed water coning behaviour, the horizontal well also proven as a pressure maintainer as shown in slowly decreasing of average reservoir pressure. The calculation shows that the Net Present Values (NPV) for both best case and worst case scenarios show a positive value for Horizontal well implemented in M Field over implementing Vertical .

Acknowledgments

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