The 2015 World Congress on
Advances in Civil, Environmental, and Materials Research (ACEM15)
Incheon, Korea, August 25-29, 2015

Overview of CO2-EOR Operation Plan in Meruap Field

*Joo Yong Lee[1)] Asep K. Permadi[2)] Hyun-Tae Kim[3)], Dae-Gi Huh[3)], Jong Myung Park[4)], Wonsuk Lee[4)], JaeHyoung Lee[3)], Yongchan Park[4)], Taewong Ahn[4)], Taehoon Lee[4)], and Kyoung buk Lee[4)]

[1), 3), 4)] *Marine and Petroleum Resources Division, KIGAM, Daejeon 305-350, Korea*
[2)] *Institute for Research and Industry (LAPI), ITB, Bandung 40132, Indonesia*

[1)] *jyl@kigam.re.kr*

ABSTRACT

One of the most accepted and widely used technologies for enhanced oil recovery (EOR) is gas flooding. Gas flooding is the injection of hydrocarbon or nonhydrocarbon components into oil reservoirs that have typically been waterflooded to residual oil. CO^2 is widely used in gas flooding, and recent focus by many governments to sequester CO^2 also provides incentive to initiate CO^2-EOR.

A scientific trial of CO2-EOR has been planned to enhance the oil recovery at the Meruap field, in the Sumatra Island, Indonesia. Reservoir characterization and phase behavior of the site have been identified, using cores, logging data, and previous production data. Additional special core characterization also has been performed to characterize immiscibility mechanisms. Potential sites were selected after reservoir simulation and performance forecasting. Operation plan and surface structures have been designed based on the numerical simulation results, and performance monitoring system are currently at the designing stage.

1. INTRODUCTION

One of the most accepted and widely used technologies for enhanced oil recovery (EOR) is gas flooding. Gas flooding is the injection of hydrocarbon or nonhydrocarbon components into oil reservoirs that have typically been waterflooded to residual oil. CO^2 is widely used in gas flooding, and recent focus by many governments to sequester CO^2 also provides incentive to initiate CO^2-EOR.

A scientific trial of CO2-EOR has been planned to enhance the oil recovery at the Meruap field, in the Sumatra Island, Indonesia. Meruap Field is located at Sarolangun

---

[1)] Principal Researcher
[2)] Professor
[3)] Principal Researcher
[4)] Senior Researcher

District, Jambi Province, about 2 km from Sarolangun City. Geologically, Meruap field is located at the Northern Part of the South Sumatra back arc basin. The area was first operated by Huffco in January 1974. The first well was drilled and successfully produced oil followed by a few more wells. In 1981, Huffco left the block due to the field economics disadvantage. In April 1984, British Petroleum (BP) signed a production sharing contract of Merangin Block within which Meruap Field was one of the fields. Again, because of some economics reasons, BP then left the Merangin Block in 1985. On July 12, 1994, PT. Bina Wahana Petrindo Meruap (PT. BWP Meruap) signed a Technical Assistance Contract (TAC) with Pertamina to operate Meruap Field for 20 years. The field has since been an oil producer.

Reservoir characterization and phase behavior of the site have been identified, using cores, logging data, and previous production data. Additional special core characterization also has been performed to characterize immiscibility mechanisms. Potential sites were selected after reservoir simulation and performance forecasting. Operation plan and surface structures have been designed based on the numerical simulation results, and performance monitoring system are currently at the designing stage.

2. WORK SCOPES

Generally, the work scopes of this study are:

- Reconstruct the geological model, reinterpretation of well data including log analysis, well correlation, and petrophysical analysis.
- Re-interpret the 2D seismic data including horizon and structural pickings.
- Overview in general on the prospect or other potential areas within Meruap Block.
- Integrate well and seismic data through well seismic tie/synthetic seismogram.
- Integrate pressure test and production data from both the existing and the newly drilled wells available.
- Continue generate well history data including drilling, completion, drill stem test, pressure test, and production data.
- Re-assess reservoir rock and fluid properties based on core and PVT data available.
- Re-determine oil and gas in-place volumes for each reservoir.
- Analyze the performance of and re-determine the driving mechanisms available including aquifer properties.
- Simulate the reservoir with steps of at least: Prepare, verify, and revise all available geological data to input into the reservoir model; Construct a reservoir model based on the verified and newly geological data; Prepare and verify all available rock, fluid, pressure, and production history data for each well to input into the reservoir model; Verify initial oil and gas in-place volumes in the reservoirs and comparatively analyze the previous calculation results; History match the oil, gas, and water productions for each well; Forecast the production performance of each reservoir for various

development scenarios and select the best one based on both technical and economic considerations; Perform economics calculation and analysis for the plan of further development (POFD) project of the field; Present progress reports of the work regularly according to the work schedule.

The following sections describe the detailed study process for the present study.

3. PROJECT REVIEW

3.1 Geophysical Evaluation

The methodology for analyzing and evaluating geophysical data plays an important role in building a geological subsurface model. The structure and shape of the reservoir model strongly rely on the results of this geophysical analysis. The commonly practiced procedure and workflow of the analysis used in this study is shown in the following Fig. 1.

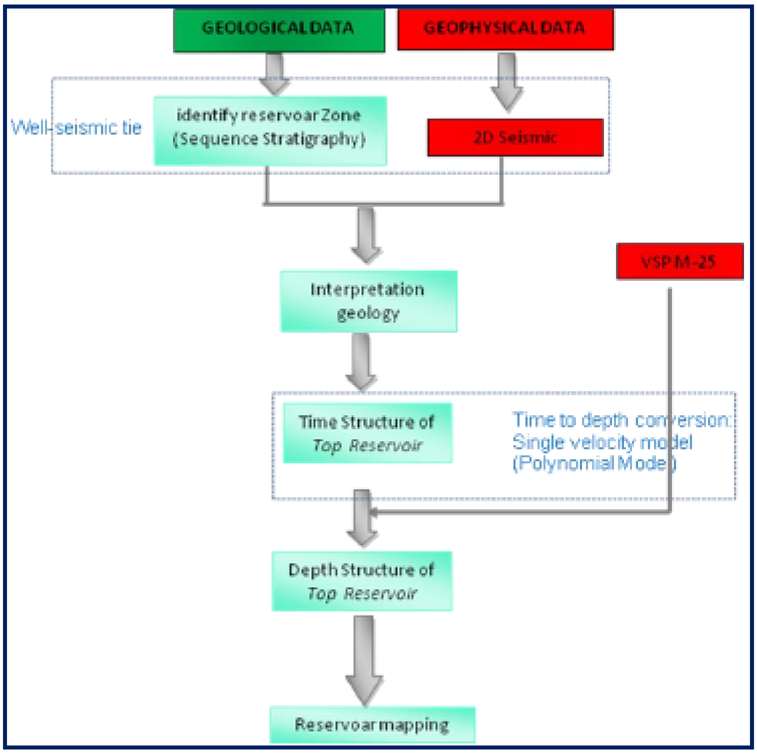

Fig. 1 Geophysical analysis workflow (LAPI ITB, 2010)

3.2 Geology and Volumetric Calcuations

The geological analysis methodology used in this study followed the standardized guidelines provided by BP Migas. The main purpose of this analysis is to build a static reservoir model to support reservoir simulation. The method for analysis and evaluation is resumed in the following flow chart shown in Fig. 2

Fig. 2 Flow chart of geological analysis methodology (LAPI ITB, 2010)

3.3 Reservoir Description
The reservoir description and analysis consist of PVT analysis, routine and special core data analysis (SCAL), well test data analysis, material balance analysis, and other engineering data evaluations. This stage is mainly to verify the reservoir static properties and to investigate other possible dynamic reservoir properties. Pressure transient data was evaluated in order to estimate the surrounding well behavior and properties including skin factors and formation permeabilities. The workflow for analyzing the pressure transient data are shown in Fig. 3.

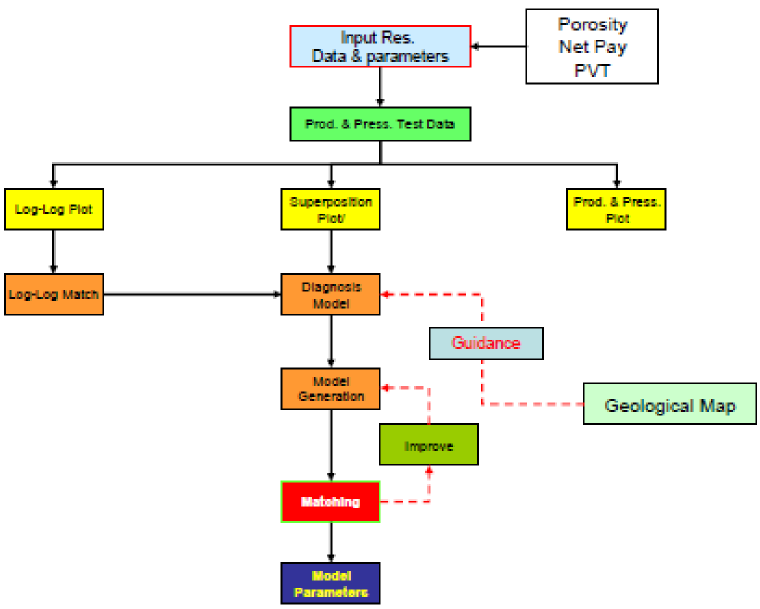

Fig. 3 Pressure transient analysis workflow (LAPI ITB, 2010)

3.4 Reservoir Simulation

The reservoir simulation workflow used in the present study consisted of several steps. Geophysical analysis results (in terms of reservoir geo-body) and geological engineering results (in terms of reservoir properties distribution) were integrated with the reservoir engineering data including but not limited to PVT, SCAL, routine core, well testing, production, and pressure data. Static geological model grids were needed to be up-scaled to generate a dynamic reservoir model that can be handled by the reservoir simulation software. An initialization process was conducted to validate the original oil in-place volumes and the pressure distribution in the model. The actual production and pressure data were used as the validating control to match the reservoir properties distribution in the history matching processes. Updating properties were needed when the results of simulation model were different from (or do not match with) the actual ones. Performance prediction and optimization processes were needed to be conducted after reasonable matches were obtained. The following Fig. 4 shows the reservoir simulation workflow used in this study.

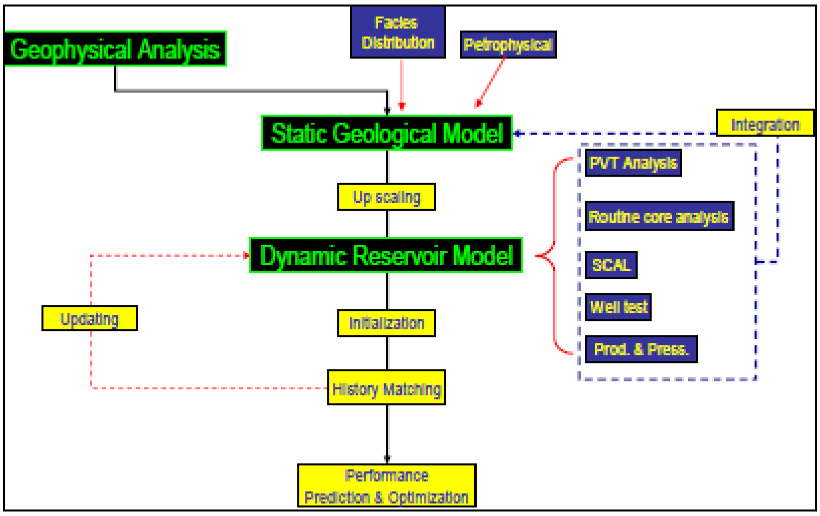

Fig. 4 Reservoir simulation workflow (LAPI ITB, 2010)

3.5 SURFACE PRODUCTION FACILITIES

Surface production facilities play an important role in an oil field development program. In the present study, the existing facilities had been thoroughly examined and some new features of the facilities would be required to design and implement. The following Fig. 5 shows the block flow diagram of the new production facilities and the upgraded Staging Area as proposed in this study.

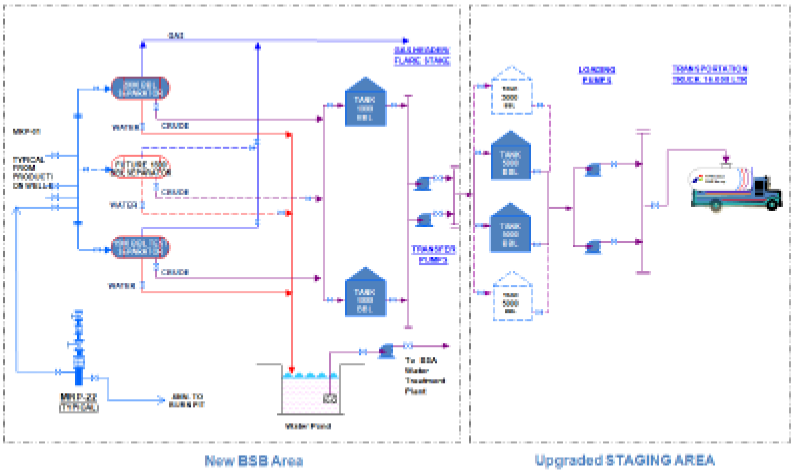

Fig. 5 Block Flow Diagram of New Meruap Field Production Facilities (LAPI ITB, 2010)

4. CONCLUDING REMARK

A study to evaluate the feasibility of CO2-EOR operation in the Meruap Field has been done. The study covered analyses and evaluations on areas of geophysics, geology, reservoir engineering, surface production facilities, and economics.
Concluding the results of geophysical and geological analysis along with the results of reservoir engineering analysis, this study has successfully built a reservoir simulation model. Completing the initialization and history matching, the model predicted the production performances of 13 (thirteen) scenarios. The investigation of the cases run provided visions on establishing the production strategy and recovery methods for future operations.

REFERENCES

LAPI ITB, (2010), "Plan of further development study for Meruap Field," *Final Report submitted by LAPI ITB Contract No. 017/BWPM/JKT/PL-JS/RSVR/2009*