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Advanced Reservoir Characterization and Horizontal Laterals
in a Class I Reservoir – East Binger (Marchand) Unit”**

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Abstract

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project is complete. Two additional vertical infill wells were drilled, completed, and brought on production during the reporting period. These were the last two of five wells to be drilled in the pilot area. Additional drilling is planned for Budget Period 3.

Overall response to the various projects continues to be very favorable. Nitrogen injection into the pilot area had doubled prior to unrelated nitrogen supply problems, while gas production and nitrogen content of produced gas have both decreased. Nitrogen recycle within the pilot area has dropped from 60% to 20%. Meanwhile, pilot area oil production has increased from 300 bpd prior to development to an average of 435 bpd for January through March 2004. March production was the highest at 542 bpd due to the addition of the two new vertical wells.

Production performances of the new wells continue to support the current opinion that horizontal wells do not provide sufficient additional production over vertical wells to justify their incremental cost.

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Quarterly Technical Progress Report – 1st Quarter 2004

Introduction

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project has been completed. Two additional vertical infill wells were drilled, completed, and brought on production during the reporting period.

A total of five new wells – three vertical and two horizontal – were drilled during Budget Period 2. Additionally, four existing producing wells were converted to nitrogen injection wells and injection compression capacity was expanded at the Nitrogen Management Facility. Monitoring of the project continues with the gathering and analysis of gas samples and pressure data.

Executive Summary

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project is complete. Two additional vertical infill wells were drilled, completed, and brought on production during the reporting period. These were the last two of five wells to be drilled in the pilot area. Additional drilling is planned for Budget Period 3.

Overall response to the various projects continues to be very favorable. Nitrogen injection into the pilot area had doubled prior to unrelated nitrogen supply problems, while gas production and nitrogen content of produced gas have both decreased. Nitrogen recycle within the pilot area has dropped from 60% to 20%. Meanwhile, pilot area oil production has increased from 300 bpd prior to development to an average of 435 bpd for January through March 2004. March production was the highest at 542 bpd due to the addition of the two new vertical wells.

Production performances of the new wells continue to support the current opinion that horizontal wells do not provide sufficient additional production over vertical wells to justify their incremental cost.

Experimental

There were no experimental methods used in the work completed during this reporting period.

Results and Discussion

The following is a detailed review of the work conducted in this reporting period.

Task 1.2.1 – Drill New Producing Wells

Figure 1 shows the well work planned for implementation in Budget Period 2. Two vertical wells, EBU 44-3 and EBU 46-3, were drilled, completed, and brought on production during this reporting period. Two horizontal wells, EBU 63-2H and EBU 64-3H, were previously drilled and brought on line. With the completion of EBU 44-3 and EBU 46-3, all major project work in Budget Period 2 has been completed.

Task 1.2.2 – Drill New Injection Wells

Well EBU 74G-2 was drilled and brought on production in early 2003. The initial planned was to convert it to injection after three to six months of production. The area appears to have been more charged up than previously expected, so this conversion has been deferred. It is now planned for mid 2004 or later.

Task 1.2.3 – Convert Producers to Injection

No additional work was done on this task. Four producing were previously converted to injection service:

- EBU 57-1 in June 2002,
- EBU 65-1 in January 2003,
- EBU 59-1 in May 2003, and
- EBU 37-3H in October 2003.

A series of problems with the Air Separation Unit (ASU) at the Nitrogen Management Facility (NMF) have limited nitrogen availability since early December 2003.

Task 1.2.4 – Construct, Modify, and Upgrade Plant Capacities

The installation of the additional injection compression was completed in May 2003. Field injection had increased approximately 1 MMscf/d, with capacity to increase another 1 to 2 MMscf/d, but injection has been limited by nitrogen availability due to a series of problems with the ASU. The ASU came back on line in late May, and injection is expected to ramp up to full capacity in June.

Task 1.2.5 – Initiate Monitoring of Pilot Area Performance

Monitoring of new well and overall pilot area performance continues. Recent data is affected by problems with the ASU, producing well downtime (downhole repairs), and newly completed wells. Overall, for the first quarter of 2004, pilot area production averaged 435 bopd, a net increase of about 145 bopd over the projected current rate without development. Production

from new wells added 230 bopd but was offset by the loss of 85 bopd from wells converted to injection, plus additional well downtime. See Figures 2 (all wells in pilot area), 3 (pre-existing wells), and 4 (new wells).

As shown in Figure 2, gas cycling has been impacted favorably. Total nitrogen produced from the pilot area has declined from 2.4 MMscf/d (4.1 MMscf/d total gas with a nitrogen content of 58%) to 1.4 MMscf/d (3.25 MMscf/d total gas with a nitrogen content of 44%). Over the same time period, total nitrogen injection has increased from 4.0 MMscf/d to 7.2 MMscf/d in March (the month least impacted by the ASU problems). As shown in the table below, this represents a total change in gas recycle from 60% prior to development to 20% in March. These figures will change and stabilize as rates from new wells and recent conversions level off, and ultimate benefits will take some time to quantify as the flood progresses.

Pilot Area Gas Recycle

	[A] Total Gas Production Rate (MMscf/d)	[B] Percent Nitrogen (%)	[C] = [A]*[B] Nitrogen Production Rate (MMscf/d)	[D] Nitrogen Injection Rate (MMscf/d)	[C] / [D] Percent Recycle (%)
Pre-Development Baseline (1H 2001)	4.1	58	2.4	4.0	60
March 2003	3.3	44	1.4	7.2	20

A secondary aspect of Pilot Area Performance Monitoring is the comparison of the performances of horizontal wells to vertical wells. Figures 5 (first 180 days) and 6 (first 18 months) provide comparisons of the rate performances of the new wells drilled in Budget Period 2. Overall, the three vertical wells (44-3, 46-3, and 74G-2) have performed on par with the two horizontal wells (63-2H and 64-3H).

EBU 44-3 is producing less oil than the others, but appears to be have been drilled into lower quality reservoir rock. Analysis of data from a pressure buildup test run in April indicates the reservoir pressure was about 4600 psi, but that the permeability to oil was only 0.05 md. The well has had trouble unloading recently; a pumping unit will be installed. EBU 46-3, on the other hand, is producing more oil than all other recent wells.

Perhaps most surprising with both of these wells are the low GORs and nitrogen contents in produced gas. Both wells are producing near solution GOR, with less than 5% nitrogen in the produced gas. EBU 46-3 is a fairly standard 80-acre infill well. Although this well has not been on production very long, the relative lack of nitrogen at this location indicates poor areal sweep.

Gas sampling also continues in the pilot area. Data collected is presented in Figure 7. As discussed in the previous report, it had previously appeared as though significant increases in nitrogen content were occurring at EBU 57-2 and EBU 58-2 (notice trends in sample data), while more recent data had suggested that those apparent increases may have been temporary or

erroneous. The latest sampling indicates that the increase at 57-2 was temporary – this will continue to be monitored – and also prompted a review of the sampling technique at 58-2. The review indicated that the higher nitrogen content indications were a result of sampling technique and were invalid. It will take some time to determine the long-term trends of nitrogen content and any changes resulting from these projects.

A number of pressure tests were also conducted within the pilot area. There are no significant changes in reservoir pressure apparent at this time. Monitoring of pilot area performance will continue throughout the project.

Task 1.2.6 – Technology Transfer Activities

Additional technical progress reports have been posted on the project web site, www.eastbingerunit.com.

Conclusion

Implementation of the pilot project of the East Binger Unit DOE Project is complete. Five new wells, three vertical and two horizontal, have been drilled, completed, and brought on production. Four producers have been converted to nitrogen injection service. Two vertical wells will be drilled and completed in early 2004, while a fifth producer-to-injector conversion was eliminated from the plan.

Early production performance suggests horizontal wells do not provide sufficient additional production over vertical wells to justify their incremental cost. It will take more time to evaluate the impact of the horizontal wells on sweep and ultimate recovery, but it is anticipated that the current opinion that vertical wells represent a better investment will not change.

Monitoring of overall performance of the pilot area continues. Overall response to the various projects continues to be very favorable. Injection into the pilot area has nearly doubled, while gas production and nitrogen content of produced gas have both decreased. Nitrogen recycle within the pilot area has dropped from 60% to 20%.

References

There are no references for this report.

Figure 1. Wellwork planned for the pilot - shown in red.

Figure 2. Production data for all wells in the pilot area.

Figure 3. Production data for wells in the pilot area that existed before DOE Project development.

Figure 4. Production data for new wells in the pilot area.

Figure 5. Comparison of production data for horizontal and vertical wells drilled in Budget Period 2 – the first 180 days.

Figure 6. Comparison of production data for horizontal and vertical wells drilled in Budget Period 2 – the first 18 months.

**East Binger Unit Pilot Area
Nitrogen Content in Produced Gas
Pilot Area Sample Data**

<u>Well</u>	December <u>2001</u>	3rd Qtr <u>2002</u>	4th Qtr <u>2002</u>	1st Qtr <u>2003</u>	2nd Qtr <u>2003</u>	3rd Qtr <u>2003</u>	4th Qtr <u>2003</u>	1st Qtr <u>2004</u>
35-2	58%	-	61%	-	63%	67%	63%	-
36-1	65%	50%	49%	46%	47%	44%	45%	50%
36-2	25%	-	29%	-	20%	-	18%	-
37-2	83%	77%	79%	80%	79%	80%	81%	81%
43-1	9%	10%	-	7%	-	6%	-	4%
44-1	69%	67%	67%	68%	71%	66%	68%	67%
44-3	-	-	-	-	-	-	-	4%
45-2	56%	58%	-	57%	59%	60%	61%	62%
46-2	62%	-	-	68%	64%	61%	62%	64%
46-3	-	-	-	-	-	-	-	-
48-1	83%	83%	84%	84%	85%	86%	87%	87%
57-2	37%	41%	39%	41%	45%	47%	40%	37%
58-2	8%	5%	-	6%	5%	29%	-	12%
59-2	44%	-	-	48%	45%	43%	39%	45%
61-1	56%	-	-	-	56%	-	59%	-
63-2H	-	-	-	-	-	16%	19%	22%
64-3H	-	23%	18%	17%	16%	23%	25%	36%
73-1	13%	21%	-	21%	-	21%	-	19%
74G-2	-	-	-	6 - 10%	10%	10%	10%	19%

Figure 7. Pilot Area gas sample data.