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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 progressing and nearing completion. Two of three planned horizontal wells have been drilled and completed. The third horizontal well will be replaced by two vertical wells, both of which will be drilled in early 2004. Based on costs and performances of all new wells, it is believed that, in the setting of the East Binger Unit, the benefits of horizontal wells do not justify the additional cost.

In addition to the drilling of new wells, the project also includes conversions of producing wells to injection service. Four wells have now been converted, and injection in the pilot area has doubled. A fifth planned conversion has been removed from the project.

Overall response to the various projects continues to be very favorable. Gas injection into the pilot area has increased from 4.0 MMscf/d prior to development to 8.0 MMscf/d in November, while gas production has decreased from 4.1 MMscf/d to 3.0 MMscf/d. The nitrogen content of produced gas has dropped from 58% to 45%. This has reduced the nitrogen recycle within the pilot area from 60% to under 20%. Meanwhile, pilot area oil production has increased, from 300 bpd prior to development to over 425 bpd in November 2003. This is down from 600 bopd in September because EBU 63-2H has begun to level off and other wells were temporarily down. This incremental rate will increase with the addition of the two vertical wells.

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Quarterly Technical Progress Report – 4th Quarter 2003

Introduction

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project continues. The major activities completed during the period were the conversion to injection of well EBU 37-3H and additional evaluation work on future infill drilling locations.

This quarterly report covers the Fourth Quarter of 2003. Monitoring of the project continues with the gathering and analysis of gas samples.

Executive Summary

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project is progressing and nearing completion. Two of three planned horizontal wells have been drilled and completed. The third horizontal well will be replaced by two vertical wells, both of which will be drilled in early 2004. Based on costs and performances of all new wells, it is believed that, in the setting of the East Binger Unit, the benefits of horizontal wells do not justify the additional cost.

In addition to the drilling of new wells, the project also includes conversions of producing wells to injection service. Four wells have now been converted, and injection in the pilot area has doubled. A fifth planned conversion has been removed from the project.

Overall response to the various projects continues to be very favorable. Gas injection into the pilot area has increased from 4.0 MMscf/d prior to development to 8.0 MMscf/d in November, while gas production has decreased from 4.1 MMscf/d to 3.0 MMscf/d. The nitrogen content of produced gas has dropped from 58% to 45%. This has reduced the nitrogen recycle within the pilot area from 60% to under 20%. Meanwhile, pilot area oil production has increased, from 300 bpd prior to development to over 425 bpd in November 2003. This is down from 600 bpd in September because EBU 63-2H has begun to level off and other wells were temporarily down. This incremental rate will increase with the addition of the two vertical wells.

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 horizontal wells, EBU 63-2H and EBU 64-3H, have been completed and brought on production. A third horizontal producing well was originally part of the Budget Period 2 Project Plan, but will be replaced by vertical well EBU 46-3. A fourth well, EBU 44-3 (also vertical), will also be drilled in the project area. As discussed in the previous Quarterly Technical Progress Report (15121R14, for 3rd Quarter 2003), performances to date of all new wells lead Binger Operations to believe that, in this reservoir setting, the additional recovery of horizontal wells does not justify their additional cost and risk.

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.

Task 1.2.3 – Convert Producers to Injection

The fourth of five planned conversions, EBU 37-3H, occurred in early October. As previously reported, EBU 57-1, EBU 65-1, and EBU 59-1 were converted in June 2002, January 2003, and May 2003, respectively.

The fifth planned conversion, EBU 61-1, has been deferred due to changes in the locations of the horizontal infill wells. It will likely still occur at some time, but has been removed from the project. There are mechanical problems with the well that led to it being shut in for the month of December 2003. A workover is currently underway.

Task 1.2.4 – Construct, Modify, and Upgrade Plant Capacities

The installation of the additional injection compression was completed in May 2003. Field injection has increased approximately 1 MMscf/d. There is plant capacity to increase another 1 to 2 MMscf/d, but injection is being limited at this time due to the high cost of electricity.

Task 1.2.5 – Initiate Monitoring of Pilot Area Performance

Monitoring of new well and overall pilot area performance continues. Two unrelated field issues in December – reduced injection due to a failure in the air separation unit at the plant and the temporary loss of two producing wells for downhole reasons – make total pilot performance for that month somewhat anomalous. In the month of November, pilot area production averaged 425 bopd, a net increase of 125 bopd. Production from new wells added 210 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 (3.0 MMscf/d total gas with a nitrogen content of 45%). Over the same time period, total nitrogen injection has increased from 4.0 MMscf/d to 8.0 MMscf/d. As shown in the table below, this represents a total change in gas recycle from 60% prior to development to 17% in November. 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
November 2003	3.0	45	1.4	8.0	17

Another aspect of Pilot Area Performance Monitoring is the comparison of the performances of horizontal wells to vertical wells. Figures 5 (first 150 days) and 6 (first 17 months) provide comparisons of the rate performances of the new wells drilled in Budget Period 2. The three wells shown were all drilled in the same area of the field, as shown in Figure 1, and have low GORs and gas nitrogen contents.

As discussed in the previous report (15121R14, 3rd Quarter 2003), the cost of a horizontal well in the East Binger Unit is about 2.5 times that of a vertical well. Although the long term sweep benefits of the horizontal wells cannot be estimated at this time, performance to date continues to support the conclusion that there is not enough additional recovery from the horizontal wells to justify the additional cost and risk. The rate performances of these wells will be continually monitored throughout the project. Eventually, as more performance data is gathered, the impact on ultimate recovery can be estimated.

Gas sampling also continues in the pilot area. Data collected is presented in Figure 7. It appeared significant increases in nitrogen content were occurring at EBU 57-2 and EBU 58-2 (notice trends in sample data). However, the latest sampling of these wells suggests this may have been temporary – or possibly data scatter at EBU 57-2 and erroneous data at EBU 58-2, due to the combination artificial lift technique of nitrogen gas and plunger lift being used on that well. 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, but this data has not yet been fully analyzed. This data will be presented and discussed in the next report. 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.

Task 1.2.9 – Modify and Update Simulation Model, etc.

Additional reservoir simulation work was completed to evaluate the benefits of a number of potential infill drilling locations within the pilot area. Figure 8 shows the locations evaluated, and Figure 9 has a table of the results.

The highest projected recoveries are for wells EBU 64-4 (162 MBO, 319 MBOE), EBU 44-3 (98 MBO, 286 MBOE), and EBU 45-3 (62 MBO, 224 MBOE). However, the model also projects losses at offset wells if these locations are drilled. With the drilling of EBU 64-4, offset horizontal well EBU 64-3H is projected to lose 100 MBO of recovery. With other potential wells, including EBU 44-3 and EBU 46-3, the offset losses are projected to be only about 10 MBO. Also, as noted in the table in Figure 9, the projection for EBU 43-2n is less reliable than the projections for the other wells due to grid effects. This location is on the edge of the fine grid area of the model. For a view of this gridding, see Quarterly Technical Progress Report 15121R11 (4th Quarter, 2002).

Based on these results, EBU 44-3 and EBU 45-3 were added to the project. Due to surface issues, the locations were moved slightly (compare Figure 1 with Figure 8). The location of EBU 45-3 had to be moved across a section line and will be drilled as EBU 46-3.

Conclusion

Implementation of the pilot project of the East Binger Unit DOE Project is nearing completion. Three new wells, including horizontal wells EBU 63-2H and EBU 64-3H, have been drilled and completed. 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. A third horizontal well was removed from the project and two vertical wells were added. Still, it will take some time to evaluate the impact of the horizontal wells on sweep and ultimate recovery.

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 doubled, from 4.0 MMscf/d to 8.0 MMscf/d. Meanwhile, gas production has decreased from 4.1 MMscf/d to 3.0

MMscf/d, with the nitrogen content of produced gas dropping from 58% to 45%. This has reduced the nitrogen recycle within the pilot area from 60% to less than 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 150 days.

Figure 6. Comparison of production data for horizontal and vertical wells drilled in Budget Period 2 – the first 17 months.

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

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

Figure 7. Pilot Area gas sample data.

**East Binger Unit
Reservoir Simulation Study
Predicted Recoveries of Infill Wells**

Infill Location	Recovery After 10 Years			
	Oil (MBO)	NGL (Mbbls)	Methane (MMcf)	BOE (MBOE)
EBU 43-2n *	23	57	213	116
EBU 43-2s	59	28	110	105
EBU 44-3	98	114	444	286
EBU 45-3	62	99	375	224
EBU 60-2	31	45	164	103
EBU 64-4	162	95	374	319
* Projection questionable due to grid effects.				

Figure 9. Simulation-predicted recoveries of infill drilling locations.