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

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Abstract

Budget Period 2 of the East Binger Unit (“EBU”) DOE Project has been. Recent activities included additional data gathering and project monitoring, plus initiation of work on an SPE paper on the modeling efforts of the project.

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 unlikely that an improvement in recovery will be sufficient to make the overall economic value of horizontal wells greater than the economic value of vertical wells.

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%.

Efforts to further disseminate knowledge gained through this project, by means of technical paper presentations to industry groups, are underway. Project monitoring and technology transfer will be focus areas of Budget Period 3.

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Quarterly Technical Progress Report – 2nd Quarter 2004

Introduction

Implementation of the work program of Budget Period 2 of the East Binger Unit (“EBU”) DOE Project was completed in March 2004. Activities conducted in this reporting period included additional data gathering and project monitoring, plus initiation of work on an SPE paper on the modeling efforts of the project.

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. The primary goal of this work is to improve recovery through a reduction in gas cycling. Data gathered to monitor the project suggests the desired result is being achieved.

Executive Summary

Budget Period 2 of the East Binger Unit (“EBU”) DOE Project has been. Recent activities included additional data gathering and project monitoring, plus initiation of work on an SPE paper on the modeling efforts of the project.

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 unlikely that an improvement in recovery will be sufficient to make the overall economic value of horizontal wells greater than the economic value of vertical wells.

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%.

Efforts to further disseminate knowledge gained through this project, by means of technical paper presentations to industry groups, are underway. Project monitoring and technology transfer will be focus areas of Budget Period 3.

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 (plus EBU 65-2, drilled early in Budget Period 3). Four producers were drilled, completed, and brought on production as part of this task:

<u>Well</u>	<u>Type</u>	<u>Month On Production</u>
EBU 64-3H	Horizontal	August 2002
EBU 63-2H	Horizontal	September 2003
EBU 44-3	Vertical	March 2004
EBU 46-3	Vertical	March 2004

Due to low gas rates and natural lift capacity, EBU 44-3 was put on rod pump in June 2004. EBU 64-3H was previously put on gas lift. EBU 63-2H and EBU 46-3 flow naturally.

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. A new well – EBU 65-2 – was drilled between 74-2 and the 64-3H in July/August as part of Budget Period 3. This well was being completed as of this writing, but will likely be converted to injection instead of converting 74G-2.

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 from December 2003 through May 2004. As shown in Figure 2, injection returned to more normal levels in June.

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 ramped up 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 and recently completed wells. Overall, for the second quarter of 2004, pilot area production averaged 621 bopd, a net increase of about 325 bopd over the projected current rate without development. Production from new wells added 413 bopd but was offset by the loss of 88 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 2.3 MMscf/d (4.15 MMscf/d total gas with a nitrogen content of 56%) to 1.6 MMscf/d (3.55 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 May-June (two-month average). As shown in the table below, this represents a total change in gas recycle from 58% prior to development to 22% in May-June. These figures will change and stabilize as rates from new wells and recent conversions level off. Benefits to this work program will continue to be monitored 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)	4.15	56	2.4	4.0	58
May-June 2004	3.55	44	1.6	7.2	22

A secondary aspect of Pilot Area Performance Monitoring is the comparison of the performances of horizontal wells to vertical wells. Figure 6 is a plot 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). Although production from 44-3 is less than each of the other wells, rock quality appears to be lower in the vicinity of this well, and recent production has increased following the installation of a rod pump. Figure 7 shows the averages of these wells. Although the horizontal well produces more than the vertical well on average, the increased production is not sufficient to justify the higher cost, as a horizontal wells cost is over two times that of a vertical well.

Perhaps most encouraging with all of the new wells are the low GORs and nitrogen contents in produced gas. As shown in Figure 8, nitrogen contents in the produced gas of all of the new wells is far below the field average of about 70%. Three of the wells – 44-3, 46-3, and 63-2H –

have been on production for less than one year, so long-term trends are still difficult to predict accurately, but the relative lack of nitrogen at the infill well locations indicates poor areal sweep. Trends at 64-3H and 74G-2 suggest it could be years before the nitrogen contents in the produced gas of these wells approach the current field average.

Gas sampling also continues at other pilot area wells. Data collected is presented in Figure 8. The most significant changes have occurred at EBU 36-1, due to impacts from EBU 37-3H. After 37-3H was brought on production in late 2001, the nitrogen content at 36-1 dropped from 65% to less than 50%. Since 37-3H was converted to injection service in October 2003, the nitrogen content has been rising again. This was expected, and is consistent with the interpretation that the predominant flow direction is east-west.

Monitoring of pilot area performance will continue throughout the project.

Task 1.2.6 – Technology Transfer Activities

Work has begun on a technical paper on the modeling efforts undertaken with this study. Plans include presenting this paper at SPE Reservoir Simulation Symposium in Houston in late January 2005.

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 has been completed. 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.

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.

Monitoring of overall performance of the pilot area continues. 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%.

Efforts to further disseminate knowledge gained through this project, by means of technical paper presentations to industry groups, are underway.

References

There are no references for this report.

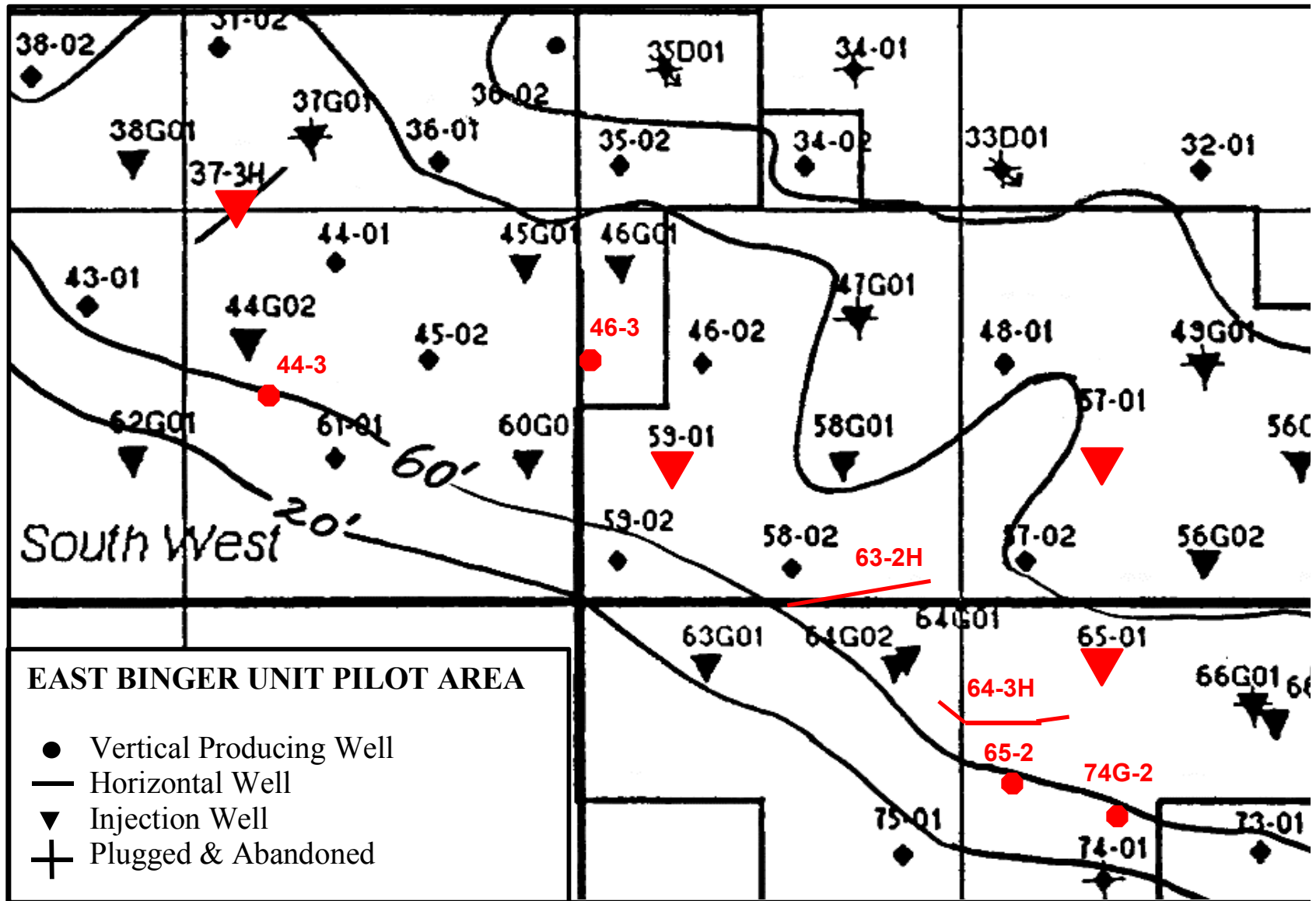


Figure 1. Wellwork planned for the pilot - shown in red.

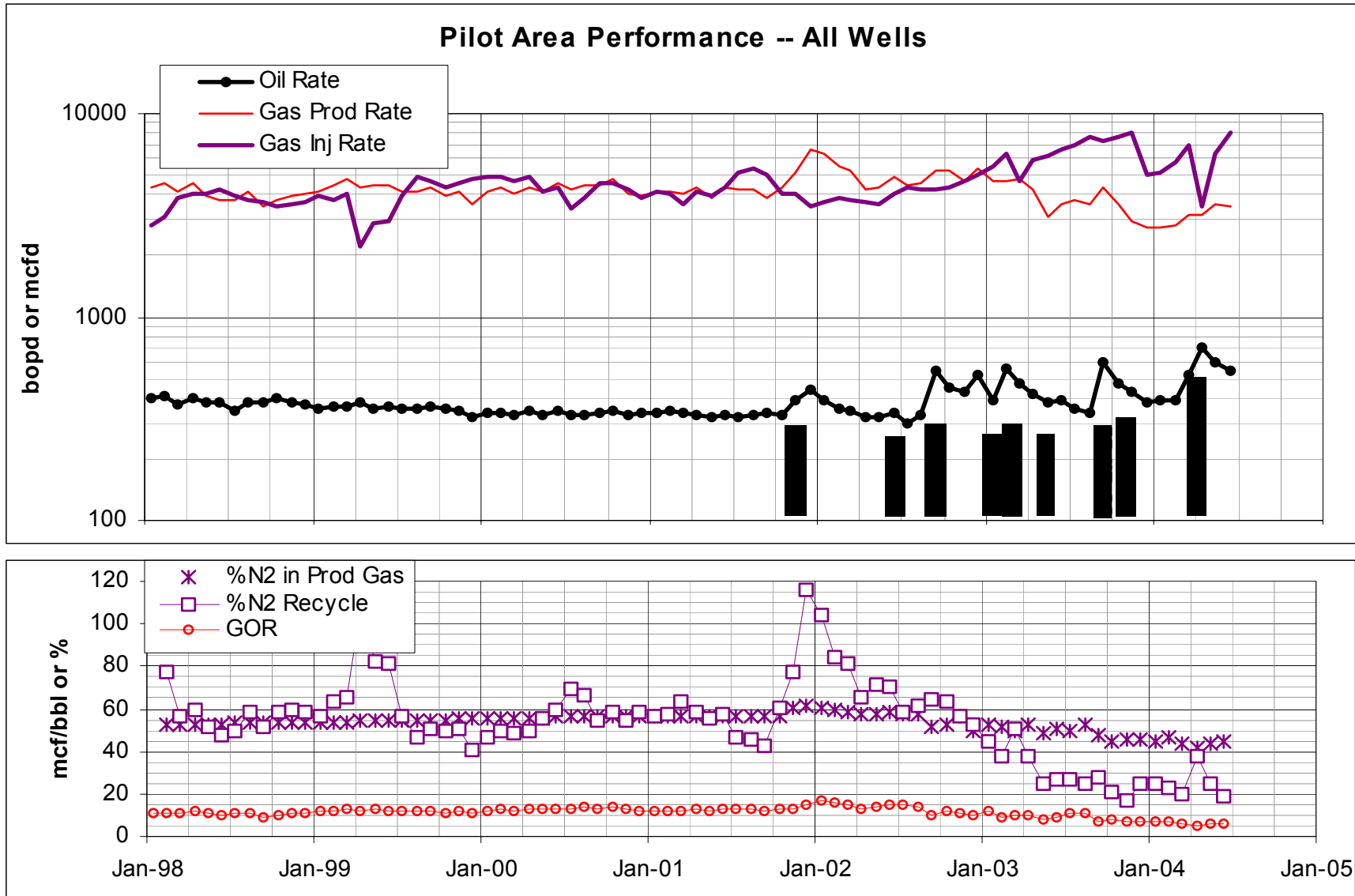


Figure 2. Production data for all wells in the pilot area.

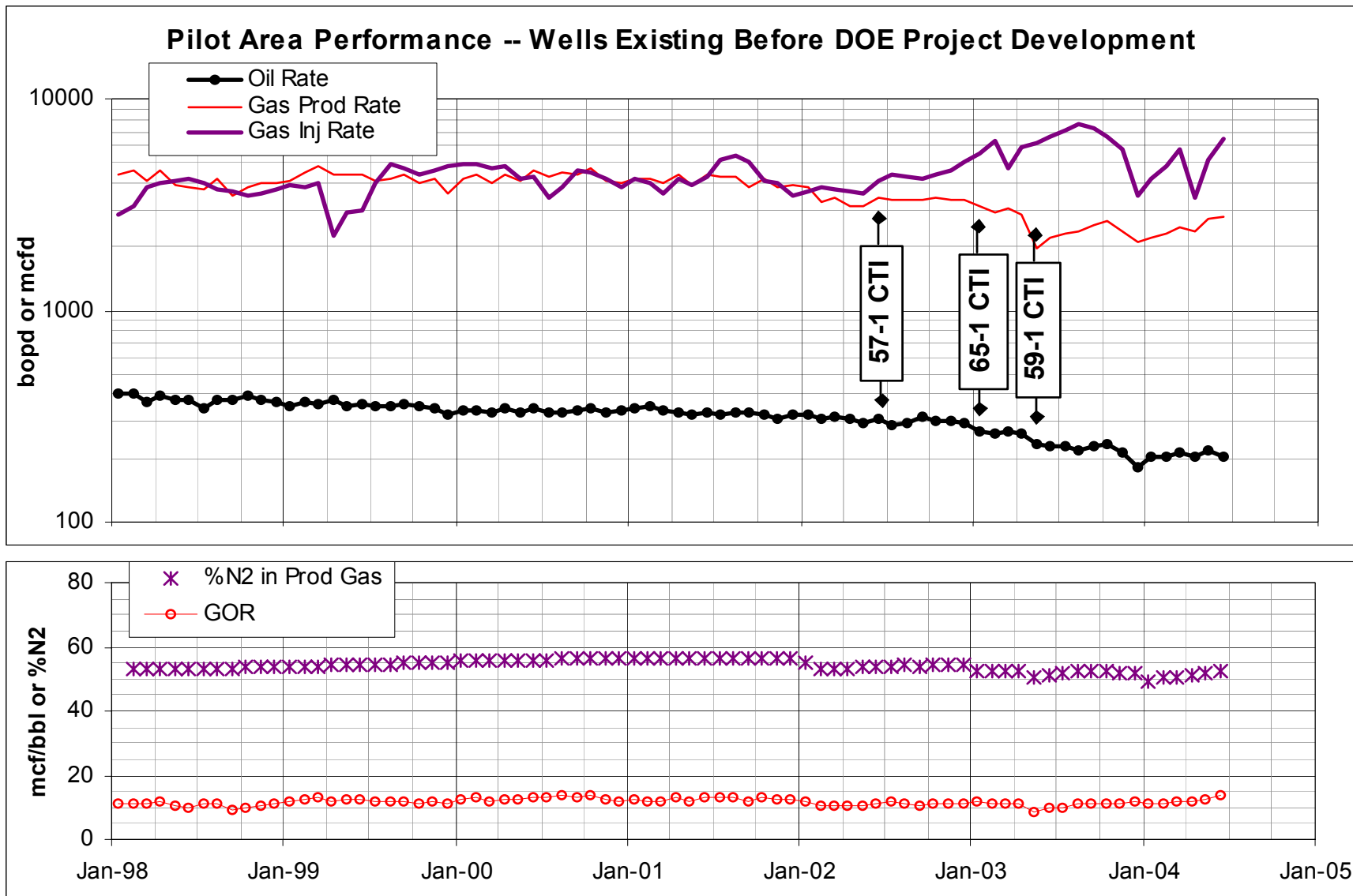


Figure 3. Production data for wells in the pilot area that existed before DOE Project development.

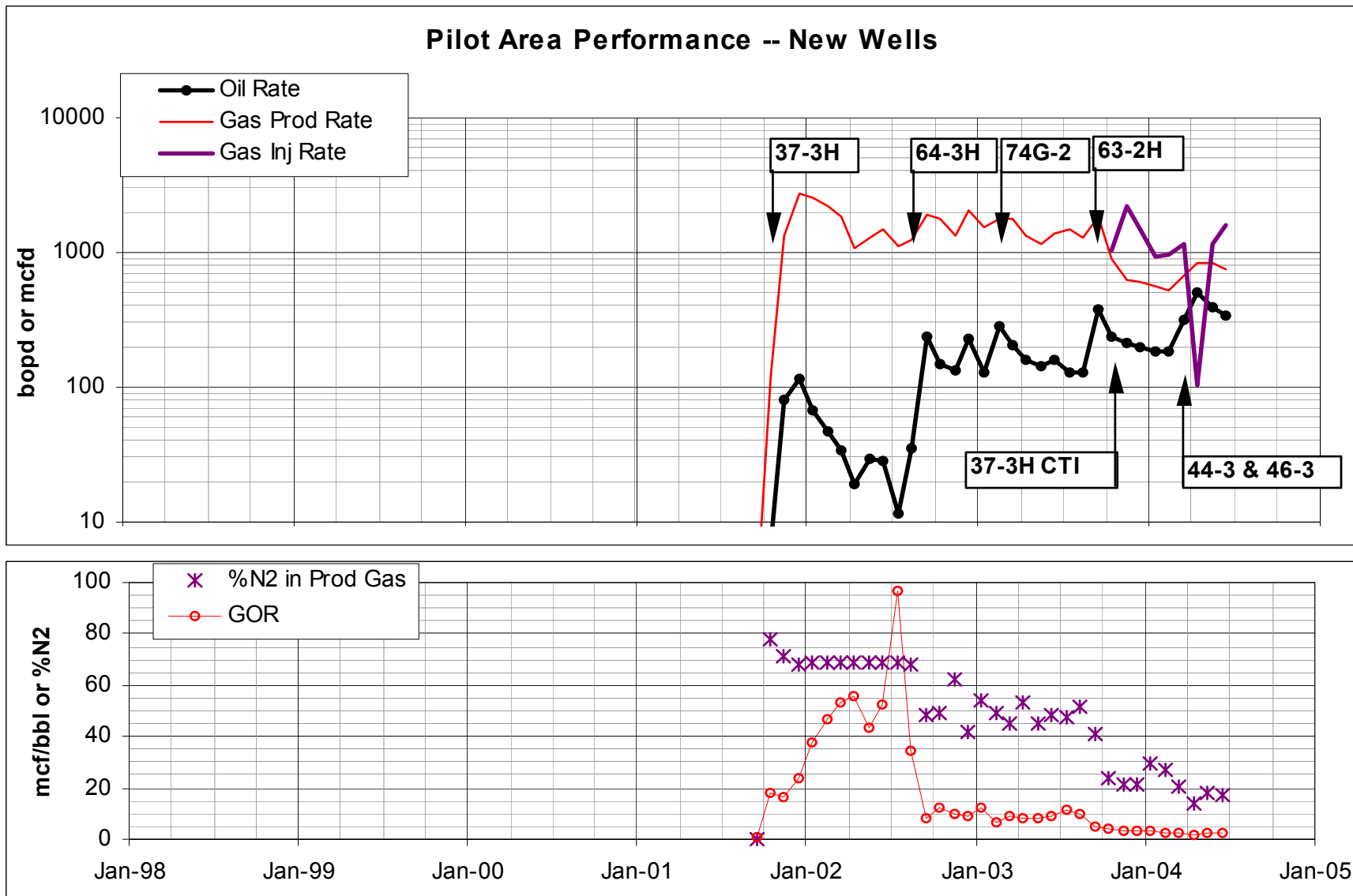


Figure 4. Production data for new wells in the pilot area.

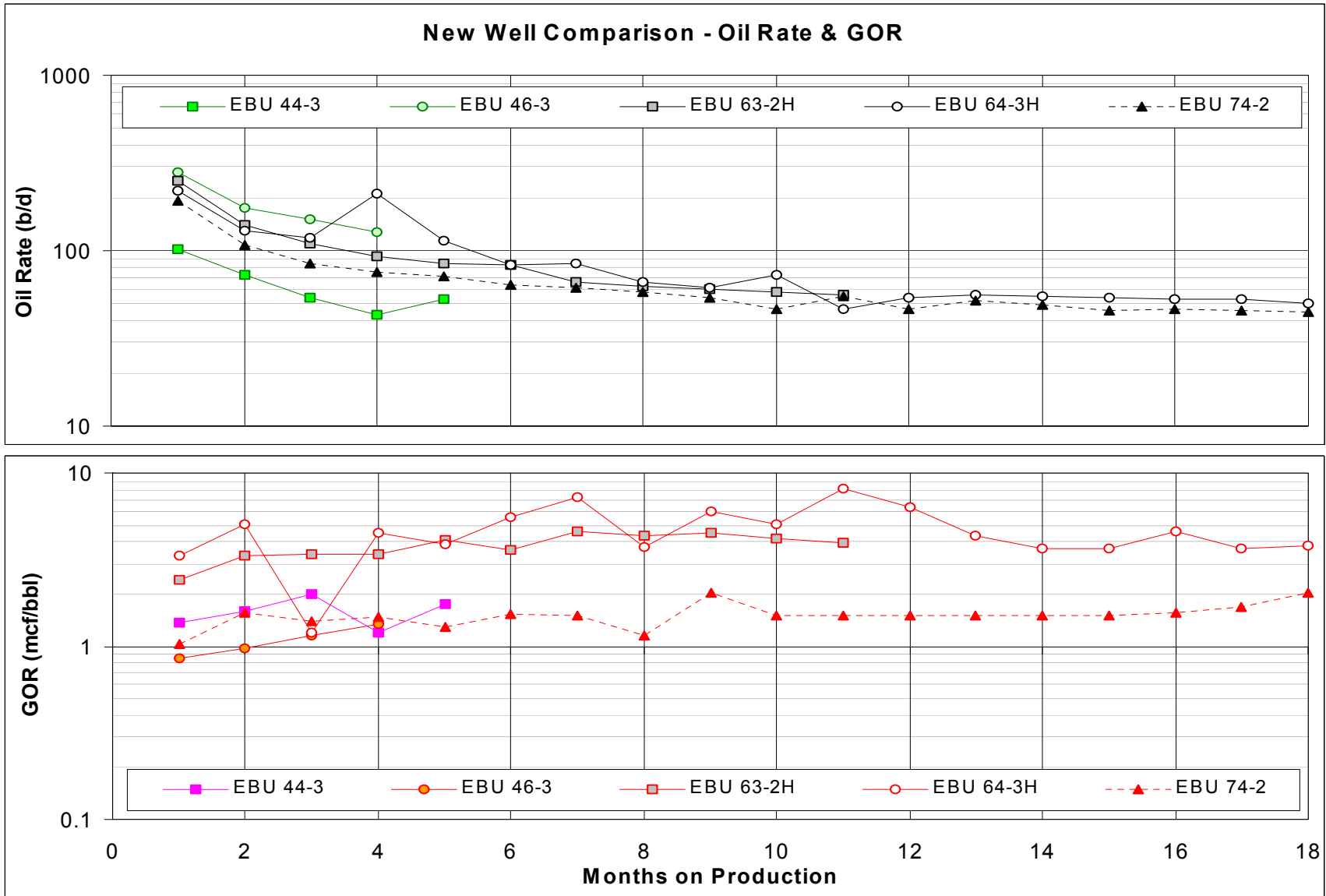


Figure 5. Comparison of production data for horizontal and vertical wells drilled in Budget Period 2.

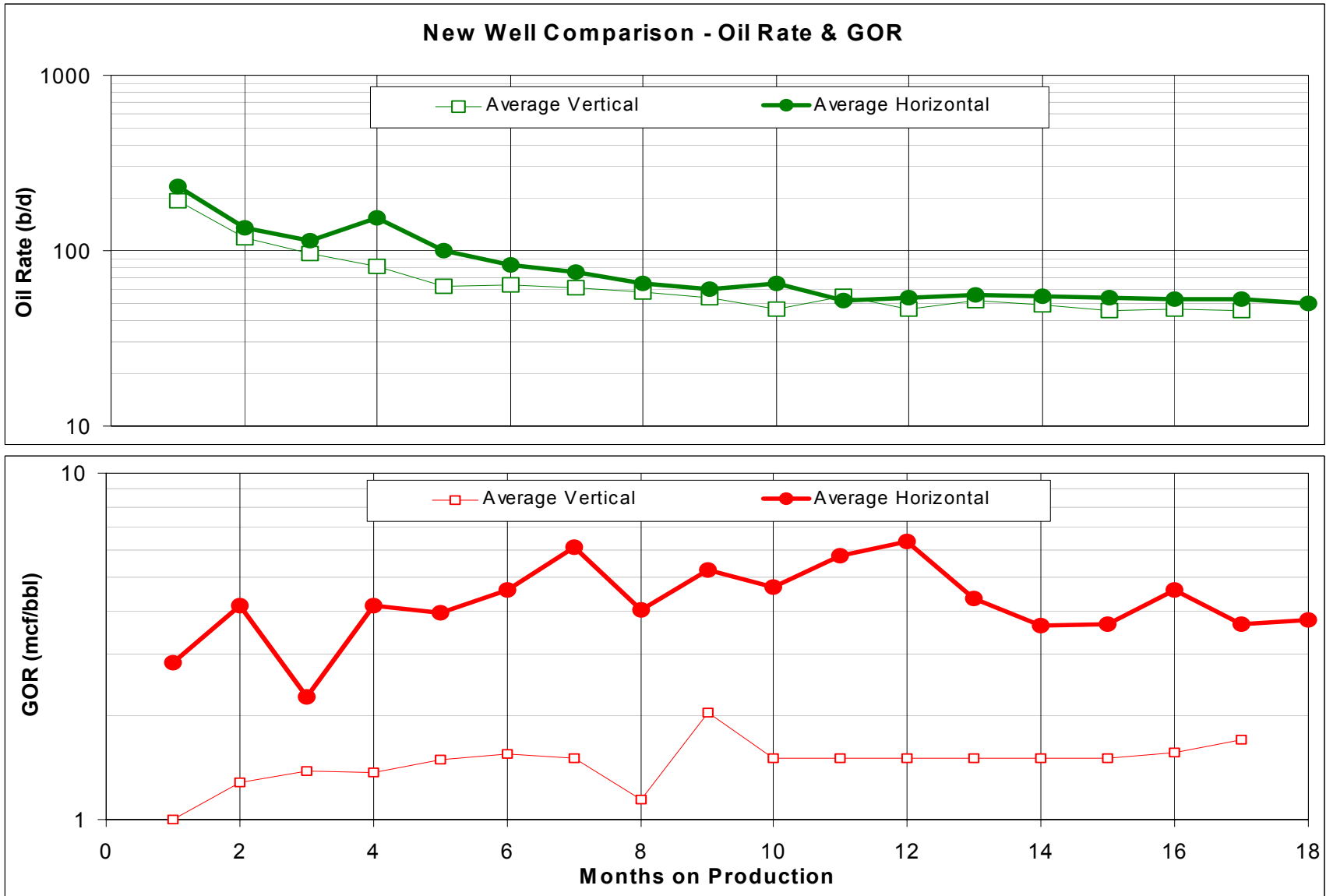


Figure 6. Comparison of average production data for horizontal and vertical wells drilled in Budget Period 2.

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

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

Figure 7. Pilot Area gas sample data.