DRILLING REVIEW OF
SOUTHERN OKLAHOMA
HOXBAR OIL TREND
Asad Khan
SOHOT GEOLOGIC TARGETS (HOXBAR)
PERFORMANCE ANALYSIS: 2013-15

• Drilling program started in late 2013.

• By Sept 2015, we had drilled 24 wells (6 Marchand, 18 Medrano). 7 at or below AFE. 16 over AFE.

• No Marchand wells had been drilled at or close to the planned AFE.

• Average Marchand drilling cost was at $5.0MM/well (46% over AFE).

• Majority of the wells were troubled. Routine wells were the exceptions.

• No Medrano wells have been drilled since 2016. Therefore, focus of this presentation will be on the Marchand.
12 ¼” Hole Size
9 5/8” 36#/ft
Surface

8 ¾” Hole Size
7” 29#/ft
Intermediate & Curve

6 1/8” Hole Size
4 ½” 13.5# Liner

<table>
<thead>
<tr>
<th>Interval</th>
<th>Fluid Type</th>
<th>Weight</th>
<th>FV</th>
<th>PV</th>
<th>YP</th>
<th>API/HTHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Spud Mud</td>
<td>8.6-9.6</td>
<td>32-40</td>
<td>&lt;10</td>
<td>5-10</td>
<td>NC</td>
</tr>
<tr>
<td>INT</td>
<td>Dispersed</td>
<td>9.5</td>
<td>60-65</td>
<td>25-30</td>
<td>20-25</td>
<td>&lt;6</td>
</tr>
<tr>
<td>Curve</td>
<td>OBM</td>
<td>8.7-9.0</td>
<td>65-70</td>
<td>20-25</td>
<td>15-20</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Lateral</td>
<td>OBM</td>
<td>8.7-9.0</td>
<td>65-70</td>
<td>20-25</td>
<td>15-20</td>
<td>&lt;5</td>
</tr>
</tbody>
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DRILLING ISSUES

• **Intermediate Section**
  - Tight hole
  - Rubble Zone
  - Stuck Pipe
  - Tools Lost in Hole
  - Open hole displacement to OBM. In some cases, resulting in wellbore instability.

• **Curve and Lateral**
  - Inconsistent BUR’s through the curve
  - Casing through the curve
  - Shale instability in the lateral during the trips
  - Challenging geology
  - Motor wear & directional failures in the lateral
  - Directional control in the lateral
CHALLENGES AND QUESTIONS

Questions

• Is casing needed through the curve?
• If not, what mud weight do we need?
• Are we using the right type of mud in the intermediate section?
• Can we reduce directional failures in the lateral?
• What needs to be changed to avoid excessive sliding in the lateral?
Noted trouble occurred only while tripping

- Increased MW from 9.0 ppg to 10.3 ppg.
- Set intermediate casing above the KOP.
- Eliminated open hole displacement of OBM.
• Analyzed pilot hole logs.
• Shifted focus from hole cleaning only to hole cleaning and wall cake.
* Caliper log showing bit (blue) and hole size
• Analyzed pilot hole logs.
• Shifted focus from hole cleaning only to hole cleaning and wall cake.
• Moved from dispersed to LSND.
• Increased water usage from 0-5 GPMs to 20-25 GPMs.
• Focused on reducing gel strengths and MBT Cap.
INTERMEDIATE MUD
INTERMEDIATE SECTION MUD

- Analyzed pilot hole logs.
- Shifted focus from hole cleaning only to hole cleaning and wall cake.
- Moved from dispersed to LSND.
- Increased water usage from 0-5 GPMs to 20-25 GPMs.
- Focused on reducing gel strengths and MBT Cap.

Tight hole issues persisted.
CURVE PERFORMANCE

• Inconsistent BUR’s through the Hogshooter with PDC.
• Replaced PDC bits with Kymera 322 (.27 RPG motor).
• Replaced Kymera 322 with 414 (.5 RPG motor).
MARCHAND CURVE PERFORMANCE

Days

2014
2015
2016
2017
2018
2019

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5

2014
2015
2016
2017
2018
2019
INTERMEDIATE AND CURVE

Top Set 7”
Change Mud

Eliminated 7”

Spud to Surface TD  Surface TD to Drill Out Surface  Drill to KOP  Pilot Hole TD  TOOH for Curve BHA  Curve TD  Set 7”

* Pilot Hole
• Havier MW resolved shale instability issues.
• Worked with geologists and directional drillers to reduce sliding and keep wellbore in the pay zone.
• Captured formation tendencies and how it affected motor yield and bit life in the lateral.
• Adjusted stabilizer placement to counteract build or drop tendencies.
• Reduced Motor/MWD failures.
SOHOT GEOLOGIC CHALLENGES

Schenk Trust 3-17HXL

Marchand J Sand 37' Thick

28 foot Fault

Livingston Land 33-4HXL

Marchand J Sand 20' Thick
LATERAL SLIDE TIME AND FOOTAGE

- Average On Bottom ROP Increased by 44%
- Average On Bottom Time decreased by 4.5 days/well

* Comparing single section laterals only
MARCHAND LATERAL PERFORMANCE
PERFORMANCE COMPARISON

Major Changes Implemented

46% Over to 3% Under AFE
RESULTS

- Avoided stuck pipe and lost in hole tools in the intermediate section.
- Consistent intermediate performance, averaging 5 days vs 17 days.
- Consistent curve performance, averaging 2.5 days vs. 5 days.
- Lowered sliding and directional failures in the lateral, averaging 13.5 days vs. 19.8 days.
- Consistent TD to RR performance, averaging 3.3 days vs. 6.3 days.
- Reduced spud to RR days from 61 days to 30 days.
- Lowered drilling cost from $5.0MM in 2014 to $2.1MM in 2019.