IMPROVEMENTS IN THE TONKAWA

2.19.2014
CODY MARTIN
Shallow prolific oil play
First Apache Tonkawa Drilled in March 2012

Cordillera acquisition expanded position

Learn and modify in 2012

Operate and excel in 2013, drill 70 Tonkawa locations

2014
CENTRAL REGION
TONKAWA TEAM

Drilling

- Sharaf Eid
- Cody Martin
- Charles Patrick
- Cliff Frates
- Eric Perner
LP VS HP TONKAWA

- **Low Pressure**
  - Top set intermediate casing, displace to OBM on drillout
  - <8.2# OBM preferred in most cases
  - Drill curves on 10°

- **High Pressure**
  - Top set casing
  - Drill curves on 12° (set as much casing as possible, cover losses)
  - 10#-10.5# MW expected
  - High connection gas
  - High trip gas
THE PROBLEM, Q4 2012/Q1 2013

Hole size and flat time reduction

WBM, PDC Curves, Batch drilling experimentation
COST REDUCTION PLAN OF ATTACK

Primary
- Hole size reduction
- Mud program optimization
- Flat time reduction
- ROP increase

Secondary
- Water based mud in lateral
- PDC curve assembly
- Multi-bowl wellhead systems
Well Name: West 2-27HA-N Rig: Cactus 109
Objective Formation: Tonkawa
Ground Elevation:
County, State: Roger Mills County, OK
RKB Elevation:
Surface Legal Location: Sec 27-16N-22W
TD (MD): ~2,000'
Surface Lease Line Footage: 370' FNL & 581' FWL
TD (TVD): ~4,600'

API #: 35-129-23696

20'' Conductor Hole @ 80'
13-3/8'' Water Casing 500'

Formation Depths (TVD)

- Anhydrite: ~3,400'
- Brown Dolomite: ~4,200'
- 9-5/8'' Casing: ~4,600'
- Blue Shale: ~5,650'
- TOC: ~7,700'
- Base Heebner: 7,789'
8-3/4'' Production hole

KOP: 8,108'
Top Douglas: 8,161'
Haskell Top: 8,434'
Tonkawa FS: 8,464'
TNKW primary sand top: 8,553'
base of main TNKW Fan: 8,583'

Directional Drilling Details

<table>
<thead>
<tr>
<th>Section</th>
<th>TMD</th>
<th>Inc</th>
<th>Azm</th>
<th>TVD</th>
<th>BUR</th>
<th>DLS</th>
<th>+N/-S</th>
<th>+E/-W</th>
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Tubular Details

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<th>Grade</th>
<th>Connection</th>
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<td>LS</td>
<td>Weld</td>
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<td>Water</td>
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<td>13 3/8</td>
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<td>ST&amp;C</td>
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<td>Prod Casing</td>
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<td>Prod Tubing</td>
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<td>N-80</td>
<td>EUE</td>
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PBHL
TMD: 12,915'
TVD: 8,567'
Inclination: 90.25°
Azimuth: 180.5°
LEARNINGS OF LARGER HOLE SIZE

- Desired production longstring, drilled 8 ¾” Lateral
  - Slower ROP in Lateral
  - More expensive casing
  - Well IP’s did not demand 5 ½” production casing

- Result
  - Drill 6 1/8” Lateral
  - Top set 7” casing above KOP, remove jewelery
  - Keep OBM, but relax properties
20" Conductor Hole @ 80'

12-1/4" Surface Hole @ 600'

Brown Dolomite 3,800' TVD
Brown Dolomite 4,800' TVD

TOC of 7" Casing @ 5300'

Heebner Base 6,957' TVD

8-3/4" Intermediate Hole 7,000' TVD

KOP - 10°/100' 7,110' TVD

Haskell Top 7,539' TVD

Tonkawa FS 7,606' TVD
Top Tonkawa Sand 7,628' TVD

Landing Pt. 7,683' TVD
8,017' MD

TOC of 9-5/8" to Surface

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VS Length 7,294
Lateral Length 6,714

TOC of 4 1/2 @ 6,800'

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<tr>
<td>Surface</td>
<td>12 3/4</td>
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<tr>
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<td>11.5</td>
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PBHL -6-1/8”
TMD: 14,732’
TVD: 7,601’
Inclination: 90.7°
Azimuth: 5.6°
LEARNINGS OF SMALLER HOLE SIZE

- Embrace Horizontal Hole Cleaning Practices
- Consistency with TCI curves (few exceptions), but slow
- Faster PDC curves, but need a fine tuned assembly. Trial and error must be acceptable, and pull for a TCI assembly when it’s still safe
- Low pressure reservoir, keep MW ≤ 8# if needed
- Engineer out all speed bumps possible
DURABILITY AND SPEED

Motor selection

- Most common lateral power sections in Apache
  - 7:8 4.5 (+/-0.46rpg)
  - 7:8 2.6 (+/- 0.26rpg)
- Higher speed motors have resulted in DBR events

Bit selection

- 6 blade 13mm cutter designs provide great ROP vs Durability across the board
CULMINATION OF EFFORTS

12,200’ Spud to TD in 12.7 Days.
Q2 Action List:

- Using 4” drill pipe in drilling 8-3/4” hole ✓
- Not using a DV tool or float collar in the 7” casing ✓
- Single stage cement job for the 7” casing ✓
- Displace to OBM, drill float equipment and FIT through directional tools ✓
- Will be looking to turnkey directional drilling contract ✓

Ultimate Goal: “48/7” Casing point
Will save Apache 3 Days & around $150,000 ✓
TONKAWA DRILLING – Q3/4 2013 ACTIONS

Q3/4 Action List:

- Reduce the cost of the soil farming ✓
- Reduce the cost of building locations (Rocking, cement pits,..) ✓
- Ask the contractor to provide 4” drill pipe and handling tools ✓
- Use speed head instead of the conventional wellheads
- Use economic 7” casing that meets the design criteria

$200,000 expected reduction
BATCH DRILLING AND SIMOPS

- Reduce environmental impact and economic burden per well
- Challenging topography in Roger Mills warrants Multi-well pads (or using existing pads) wherever possible
- Prolific BLM and ODWC locations exist, lowest footprint is best

- Significant savings with skid rigs and batch drill capability
EFFICIENCY + BATCH DRILLING

Approximate Actual cost, M$

- 8-3/4” Lateral
- 6-1/8” Lateral
- Efficiencies
- Batch Drilling

45% Cost Reduction
2014+

- Aggressive casing designs
  - Less 7” casing, where does it balance?
- WBM vs OBM
  - Potential savings greater than the induced risk?
- PDC vs TCI curves
  - Solid build rates vs PDC Speed and no KRev limitation
    - Important for 3D or extended curves for pad work
- Drilling shaly/silty streaks
  - Can completions perform an effective frac?
QUESTIONS

Thank you for listening.