Improvements in the Granite Wash: Black Kettle Field

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Greater Mid Continent Asset

- Position Assembled via Multiple Acquisitions starting from 2013 - 2015
  - Laredo Petroleum
  - SM Energy
  - QEP
  - Linn Energy
- EnerVest & Four Point Energy JV Formed in 2014
- Peak of 11 Rigs in January 2015
- Limited Capital Budget for 2016
Black Kettle – Key Improvements

- Casing Design Evolution
- Drilling Fluid Approach
- Managed Pressure Drilling Operations
- Curve Drilling Practices
- Results
Casing Design Evolution

**Generation 1**
- Upper Intermediate
- Brown Dolomite Concerns
- 7” Landed in Target
- All API Connections

**Generation 2**
- Eliminated 1st Intermediate
- Downsize Surface Casing
- Top Set Target
- 7” Casing Failures
  - Semi Premium Connections
  - 7” DV Tool

**Generation 3**
- 7” Casing Failure
  - 4-1/2” Longstring with Premium Connection in Vertical
  - Eliminate DV Tool on 7”
  - Deeper Set 7”
  - Enhance MPD Operations
Intermediate Casing Point
Mud Program

Generation 3

- LSND, 9.0 ppg, 40 sec/qt VIS
- Utilize pre-hydrated gel hi-vis sweeps

- LSND to 4500' and displace to DISPERSED w/ 10 ppb CS Hulls
- API FL < 20
- 9.0 ppg, 40-45 sec/qt VIS
- pH 11-12, Excess Lime 0.5 ppb minimum

- OBM, 10.7-11.5 ppg, 40 sec/qt VIS
- 80/20 OWR
- HTHP @ 250°F: 8-10
- 6/3 Rheologies: 7-10

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MPD – MW Window

**BKN**
- Displace intermediate cement job w/ 10.0 ppg ORM
- Increase MW to 11.0 ppg by curve landing
- Drill w/ 9.0 ppg to 7” casing point @ 11515’

**BKS**
- Displace intermediate cement job w/ 10.5 ppg ORM
- Increase MW to 11.0 ppg by curve landing
- Drill w/ 9.0 ppg to 7” casing point @ 12500’

Maintain MW at 11.0 ppg to TD, using ECD and SBR to control pressure - Increase on parameters only
MPD Choke Manifold

- Manual Choke
- 10k PSI
- From Mud Cross
- Equalizing Loop
- Hydraulic Choke
- From RCD
- To Gas Buster
- To Panic Line

Standard Manifold

Auto Choke Manifold
Mud Costs

7" set above Cleveland
Curve Drilling Improvements

- Initially drilled with Insert bits
  - 4-5 bit runs per curve
  - Trip time
- Implemented Turbine and Impreg curve drilling
  - Single run
  - LCM sensitive
Depth vs Days – BK South
Design Comparison, Days

Black Kettle North

Black Kettle South

Data limited by:
Expression
Color by
Generation

48 Days
Design Comparison, Cost

$5.345MM
Conclusions

- Casing design, mud program, MPD operations, and curve drilling practices significantly reduced:

- **Spud to RR Days**
  - BKN: Decrease ~26 Days or 35% (Excluding Geo ST Time)
  - BKS: Decrease ~26 Days or 30%

- **Mob through RR Costs**
  - BKN: Decrease ~$1.355MM or 20% (Excluding Geo ST Cost)
  - BKS: Decrease ~$1.199MM or 16%
Questions?