Dynamic MudCap Drilling in the Granite Wash Formation

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Presentation Outline

- LINN Energy Overview
- Mid-Continent Drilling Program
- Extreme Lost Circulation Challenges
- MudCap and Dynamic MudCap Drilling
- LINN Energy Water Recycling Program
- Summary
LINN Energy Overview

- **9th largest public MLP/LLC and 12th largest domestic independent oil & natural gas company**
  - LINE IPO in 2006 with enterprise value of ~$713 million
  - Equity market cap $9.1 billion
  - Total net debt $5.6 billion
  - Enterprise value $14.7 billion

- **Large, long-life diversified reserve base**
  - ~5.1 Tcfe total proved reserves
  - 64% proved developed
  - 45% oil and NGLs / 55% natural gas
  - ~17 year reserve-life index
  - >15,000 gross productive oil and natural gas wells

- **Large inventory of low risk and liquids-rich development opportunities**
  - Jonah Field – ~650 locations
  - Granite Wash – ~600 horizontal locations
  - Wolfberry – ~400 locations
  - Bakken – ~800 horizontal locations
  - Cleveland – ~165 horizontal locations
  - Kansas Hugoton – ~800 locations
  - Salt Creek Field – CO₂ flood

Note: Market data as of January 25, 2013 (LINE and LNCO closing price of $38.65 and $39.59, respectively). All operational and reserve data as of December 31, 2011, pro forma for closed 2012 acquisitions and joint venture (“JV”). Estimates of proved reserves for closed 2012 acquisitions and JV were calculated as of the effective date of the acquisitions using forward strip oil and natural gas prices, which differ from estimates calculated in accordance with SEC rules and regulations. Estimates of proved reserves for closed 2012 acquisitions and JV based solely on data provided by seller. Source: Bloomberg.

(1) Pro forma for LNCO IPO (assumes net proceeds used to repay debt outstanding).
(2) Well count does not include ~2,500 royalty interest wells.
(3) Average working interest of ~7%.
Mid-Continent Drilling Program

LINN Energy
Mid-Continent Division
Core Drilling Area

Wheeler
Elk City
Oklahoma City
Core Area Drilling Program

- Over 600 horizontal locations
  - Granite Wash
  - Hogshooter
  - Atoka

- Dynamic MudCap Drilling is utilized in DYCO Area

- Dynamic MudCap Drilling represents a very small part of LINN Energy’s drilling program
LINN’s Unique Position In The Granite Wash

- Produce from eight separate zones
- Each zone bears a unique production profile
  - Oil
  - Liquids-rich gas
  - Dry gas
- Enables LINN to adapt its drilling program
  - Focus on highest returns
- Recently shifted entire drilling program to focus on oil
## Horizontal Well Initial Production Rates

<table>
<thead>
<tr>
<th>Formation</th>
<th>Oil</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hogshooter</td>
<td>500 - 5,000 BPD</td>
<td>1 - 10 MMCF/D</td>
</tr>
<tr>
<td>Granite Wash</td>
<td>10 - 2,500 BPD</td>
<td>2 - 30 MMCF/D</td>
</tr>
<tr>
<td>Atoka</td>
<td>2 - 75 BPD</td>
<td>8 - 50 MMCF/D</td>
</tr>
</tbody>
</table>
Extreme Lost Circulation

- Lost 3,000 bbls oil-based mud in several wells
- Over 15,000 bbls lost fluid is possible in the area
- Leads to hole stability problems
- Drilling can become uneconomic, especially with OBM
- Hole is not kept full so well control is poor
- Light, viscous fluid is placed in annulus
- Sacrificial fluid is pumped down drillpipe
- No attempt is made to cure lost circulation
- Well control is maintained
- Works in vertical or horizontal wells
MudCap Drilling Variations

- Floating MudCap Drilling
- Pressurized MudCap Drilling
- Constant Bottom-Hole Pressure Method
- Dual Gradient Pressure Method

Managed Pressure Drilling
Project Team Members

- LINN Energy and Signa Engineering designed DMCD system
- Signa Engineering provided training and onsite engineering support
- Baker Hughes, Anchor, and Ensign provided additional support with Directional Drilling, Cement and Liner Equipment, Drilling Fluids, and Rig Equipment
Dynamic MudCap Drilling

- Sacrificial fluid (produced water) is pumped down drillpipe and annulus independently and simultaneously
- Produced water is supplied by LINN Energy Water Recycling Program
- Maintains excellent well control and hole stability
- Very inexpensive drilling fluid
Typical Granite Wash Well Design

17-1/2” Hole
- <9.5 ppg Water-Based LSND Mud

12-1/4” Hole
- 13-3/8”, 48.00 ppf, J-55, LTC Casing set at 500’
  - Ground-Water Protection
- 9-5/8”, 40.00 ppf, L-80 LTC Casing set at 6,800’

8.0 – 9.5 ppg Oil-Based Mud

8-3/4” Hole
- Target Depth: 12,000’ TVD @ 0’ VS with 90.5 deg dip

5-1/2”, 17.00 ppf, J-55 LTC or GBCD Casing

TVD: 12,000’
TMD: 17,500’

Water-Based LSND Mud

Oil-Based Mud
DMCD Granite Wash Well Design

17-1/2" Hole

<9.5 ppg Water-Based LSND Mud

12-1/4" Hole

<9.5 ppg Water-Based LSND Mud

13-3/8", 48.00 ppf, J-55, LTC Casing set at 500'
Ground-Water Protection

9-5/8", 40.00 ppf, L-80 LTC Casing set at 6,800'

8.0 – 9.5 ppg Oil-Based Mud

12-1/4" Hole

8-3/4" Hole

6-1/8" Hole
Drill lateral with produced water

7", 26.00 ppf, P-110 LTC or GBCD Casing set at 12,400'

Target Depth: 12,000' TVD @ 0' VS with 90.5 deg dip

TVD: 12,000'
TMD: 17,500'

4-1/2", 13.50 ppf, J-55 LTC or GBCD Casing
With Baker Frac Point Liner (Uncemented)
20 Stage Completion
DMCD Equipment Requirements

- Rotating Control Device (to apply pressure to annulus)
- Independent Annular Pump(s)
- Fluid Storage Tanks
- Annular Pressure Gauge (Electronic: 2000 psi with 1 psi increments)
- Conventional MWD with Bottom-Hole Pressure Sub
- LOTS of fluid
DMCD Surface Equipment Schematic

Annular Fluid Tanks

Pre-Mix Pit

Annular Pumps

2" Check Valve

Pressure Transmitter

Fill-Up Line

To Trip Tank

2" 1502 Line

Orbit Valve

Returns Flow Line

Well Control Choke Line

To Standpipe

To Standpipe

Rig’s Mud Pumps

Pit

Annular Fluid

Pre-Mix

Orbit Valve

Well Control Choke Line

Well Control Kill Line

Fill-Up Line

Drawing by Signa Engineering Corp, October, 2012
Rotating Control Device

Controlled Pressure Drilling®

Model IP 1000 Rotating Control Device
Annular Pumps

- Union TX-200 Triplex Pump (200 HP)
- Powered by 225 HP C7 Caterpillar I-6 Diesel
Additional DMCD Equipment

16” Riser for Water Supply

Centrifugal Pump with Valve Manifold

Fluid Storage Tanks
LINN Energy Water Recycling Program

- Water used for fracture stimulation purposes
- Construction initiated in 2010
- Reduces demand on aquifer
- Minimizes produced water disposal
- Eliminates trucking

- 17 water containment ponds
- 87 miles of pipeline
- 4 million bbl water storage
Water Recycling System Pipeline Map

Expanded purpose for Dynamic MudCap Drilling

Note: Small area of system shown
Drilling Options with DMCD

- Conventional Circulation with or without LCM
- Partial Circulation with Produced Water
- Dynamic MudCap Drilling (for extreme lost circulation)
- Initiate Formation Break-Down
Dynamic MudCap Drilling Summary

- 5 Wells Drilled (3 drilled, 2 currently drilling)
- Successful - Very little trouble time with DMCD
- Water has been compatible with formation
- Incremental equipment costs less than $3,000 per day

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Total Depth</th>
<th>Lateral Length</th>
<th>Water Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunter Hefley 34-8H</td>
<td>16,927’</td>
<td>4565’</td>
<td>169,645 bbls</td>
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<tr>
<td>Hunter Hefley 34-9H</td>
<td>16,965’</td>
<td>4488’</td>
<td>55,263 bbls</td>
</tr>
<tr>
<td>Lohberger 25-7H</td>
<td>15,975’</td>
<td>3550’</td>
<td>31,606 bbls</td>
</tr>
</tbody>
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Summary

- Important asset for LINN Energy in multiple formations
- Challenging wells with extreme lost circulation
- Dynamic MudCap Drilling is a specialized drilling technique
- Integrated with LINN Energy Water Recycling Program
- Proven success in horizontal drilling