Drilling Rig Electrification – Barnett and Beyond
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By: Ryan Stricklin - Drilling Engineer, Barnett Shale
Presentation Outline:

- Electric Drilling Project
  - Project Overview
  - Rig Fleet / Equipment
  - Current Progress
  - Economic Summary
Rig Electrification Overview

- Originated at DFW Airport in 2007, expanded into entire Barnett district in 2009
  - Use of mobile transformer skids to run diesel-electric rigs on grid power
  - 7 transformer skids available in the Barnett (owned by Great Plains, Chesapeake Subsidiary)
  - Contracting electrical engineering/consulting through Rapid Power Management; Dallas, TX
  - 12 rigs in the Barnett fully capable of utilizing transformer skids
    - Nomac 20 series, Nomac 140 series (Formerly Mountain), Trinidad 110, 111, 129 and 130.
  - Ideal for pad drilling or an area with power grid in place and nearby
    - Each pad incurs a cost for engineering, layout design, equipment installation, Right of Way, and electrical hookup.
Benefits of Electricity for Drilling Rigs

- Eliminates Drilling Rig Emissions
  
  CO2 Emissions  
  (4.2 Tons per Rig per Day) reduced to +/- 0

  Nox (Nitrogen Oxides)  
  55 TPY (4.6 Tons per Well) reduced to +/- 0 TPY (Tons per year)

  VOC (Volatile Organic Compounds)  
  2.5 TPY (0.2 Tons per Well) reduced to +/- 0 TPY

- Eliminates Drilling Rig Noise

  75 dB reduced to +/- 0 dB

- Economic Benefits: (Saves +/- $43,000 per well depending on diesel prices)
Electric Drilling Fleet

Nomac Drilling
National 610 Drilling Rigs
Derrick Height: 170’
750 HP
Fuel Usage: 1500 GPD
Electric Power: 1500 kilowatts
Voltage: 600 Volts

Nomac 140 Series
Drillmec HH-220 Drilling Rigs
Derrick Height: 100’
1500 HP
Fuel Usage: 2015 GPD
Electric Power: 2200 kilowatts
Voltage: 600 Volts

Trinidad Drilling
Victory 1500 AC Drilling Rigs
Derrick Height: 142’
1,500 HP
Fuel Usage: 1800 - 2200 GPD
Electric Power: 1500 kilowatts
Voltage: 600 Volts
Site Layout with Current Equipment

- Transformer Skid Components - Single Platform
  - Main Switch
  - Harmonic Filter
  - Dual Voltage Transformer
  - Voltage Regulators
  - Main Switch

- Transformer Skid
- SCR House
- Drilling Rig
- Gen1
- Gen2
- Gen3

- Chesapeake/Great Plains Owned
- Drilling Contractor Owned

- 12.47 or 25 kV Underground Conductor on Pad

- 12.47 or 25 kV Electric Lines

- Metering on Pole or Pad Mounted Meter

- Chesapeake Energy
Electrical Skid Design Improvement

June 2008

- 4.16 kV to 600 Volt
- 2500 kVA Transformer
- 525 kVAR Harmonic Filter

March 2009

- 12.5 or 25 kV to 600V
- 3750 kVA Transformer
- 1000 kVAR Harmonic Filter
All Electrical Connections are Controlled Access

Incoming Power Connections

Rig Connections located behind cover
Transformer and Capacitor Bank / Harmonic Filter

- Transforms 12.47 or 24.9 kV to 600V for Rig Power
- Mitigates rig power distortion on utility network
- Provides Main 600 V Disconnect for Rig.

Main 600 V Electric Disconnect (behind panel) door
Project Evolution

- From 1 padsite outside DFW Airport in 2009 to 102 padsites as of December, 2011

- 56 padsites 100% ready; 46 padsites in progress

- 850 wells planned to be drilled on electricity

- 79 wells drilled on electricity to date (30 padsites) – 1,396 drilling days

- Rig capability taken from 6 rigs to 12
Economic Summary

Diesel Fuel Savings

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering, Installation, Right of Way, Hook-Up Cost (per well)</td>
<td>$34,000</td>
</tr>
<tr>
<td>Average Cost of Electricity (13,108 kWh/day)</td>
<td>$14,160</td>
</tr>
<tr>
<td>Average Cost of Drilling Well on Electricity</td>
<td>$48,160</td>
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<tr>
<td>Average Cost of Drilling Well on Diesel (1,730 gal/day @ $3.50 per gal)</td>
<td>$90,825</td>
</tr>
<tr>
<td>Net Savings of Drilling Well on Electricity</td>
<td>$42,665</td>
</tr>
<tr>
<td>Total Savings of Wells Drilled on Electricity to date (excluding DFW)</td>
<td>$3,370,535</td>
</tr>
<tr>
<td>(79 wells)</td>
<td></td>
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</tbody>
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Estimated Savings for 21 of the pads we’ve drilled on: $8,618,330 (202 wells)
### GM Pad Economics (Barnett)

<table>
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<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction, Hookup/Disconnect, Engr. (Per well)</td>
<td>$8,130</td>
</tr>
<tr>
<td>Transformer skid rental - Great Plains ($1000/day)</td>
<td>$15,000</td>
</tr>
<tr>
<td>Average Cost of Electricity (13,108 kWh/day)</td>
<td>$12,765</td>
</tr>
<tr>
<td><strong>Average Cost of Drilling Well on Electricity (15 days)</strong></td>
<td>$35,895</td>
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<tr>
<td>Average Cost of Drilling Well on Diesel</td>
<td>$78,750</td>
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<tr>
<td>(Nomac 29 – 1,500 gal/day @ $3.50 per gal)</td>
<td></td>
</tr>
<tr>
<td><strong>Net Savings of Drilling Well on Electricity</strong></td>
<td>$42,855</td>
</tr>
<tr>
<td><strong>Total Savings of Wells Drilled on GM Pad w/ Electricity (15 wells)</strong></td>
<td>$642,825</td>
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</tbody>
</table>
Future Plans

- **Continue to bring electricity to padsites that are ideal:**
  - High Impact
  - >7 wells on the pad
  - Grid Power readily available
  - Economical installation

- **Better optimize drilling schedule to keep all 7 skids running**

- **Complete installation on enough padsites to completely fill all rig lines that have electrical capability**

- **Possible expansion into other areas**
Questions?