DFW Airport Project – Barnett Shale
Drilling Rig Electricity

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Presentation Outline

- DFW Airport Project Review
- Drilling Rig Electricity Project
- Electricity Continuous Improvement
- Conclusions
DFW Airport Project Overview

- 2nd Largest Airport in United States
- 3rd Busiest Airport in United States
- 18,453 Acres
- Up to 5 Drilling Rigs
- 53 pad sites
- 330 Horizontal Barnett Shale Wells
- 2 Salt Water Disposal Wells

DFW Airport Project Milestones

- 10/2006 Lease signed for $186 million
- 12/2006 Started seismic survey
- 5/2007 First well drilled
- 8/2007 First gas production
- 9/2007 First drilling rig electricity test
- 5/2008 Full implementation of electricity
DFW Airport Project Considerations

- Safety
- Security
- Environment and Emissions
- Drilling rig heights in restricted airspace areas
- Derrick lighting
- Radar interference

DFW Airport
Original Development Plan
Approximately 330 Wells
53 Pad Sites
DFW Airport
Actual Drilled Wells

110 Horizontal Wells
DFW Airport Drilling Statistics

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Record</th>
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</thead>
<tbody>
<tr>
<td>Drilling Days</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>True Vertical</td>
<td>8,500 ft</td>
<td>9,563 ft</td>
</tr>
<tr>
<td>Total Vertical</td>
<td>12,514 ft</td>
<td>16,547 ft</td>
</tr>
<tr>
<td>Horizontal</td>
<td>3,774 ft</td>
<td>7,359 ft</td>
</tr>
<tr>
<td>Vertical Section</td>
<td>4,251 ft</td>
<td>9,356 ft</td>
</tr>
</tbody>
</table>

Drilling Rig Electricity Project

- Why? – To reduce drilling rig emissions at DFW Airport – FAA Rules
- Production facilities sharing electrical installations
- 25,000 Volts on electricity grid at DFW Airport
- Compliance with IEEE-519 Standard for voltage harmonics
- Installation of harmonic filters (capacitors)
- Achieved all 5 drilling rigs running on electricity
DFW Airport Rig Fleet

**Nomac Drilling**
National 610 Drilling Rigs  
Derrick Height: 170’  
Horsepower: 750 HP  
Fuel Usage: 1600 GPD  
Electric Power: 1500 kilowatts  
Voltage: 600 Volts

**Mountain Drilling**
Drillmec HH-220 Drilling Rigs  
Derrick Height: 100’  
Horsepower: 1500 HP  
Fuel Usage: 2200 GPD  
Electric Power: 2200 kilowatts  
Voltage: 600 Volts

### Benefits of Electricity for Drilling Rigs

- Eliminates Drilling Rig Emissions  
  NOX (Nitrogen Oxides)  
  VOC (Volatile Organic Compounds)
- Eliminates Drilling Rig Engine Noise
- Economic Benefits  
  Saves +/- $60,000 per well with $4.00 diesel prices
Disadvantages of Electricity for Drilling Rigs

- Electric power may not be available at all locations
- Logistics are difficult
- Relies on utility companies
- Requires equipment investment
- Can be interruptions in electric power

Voltage Distortion

- Regulated by IEEE-519 Standard
- Voltage distortion can disrupt and cause damage to electronics (computers and radar)
- Harmonic filters (capacitors) reduce voltage distortion
DFW Airport Typical Site Layout

Drilling Rig Electrical Equipment
Transformer Skid

600 Volt Switch

4.16 kV to 600V Transformer

5kV Switch

Voltage Regulator Skid

Voltage Regulators
Utility Equipment

Permanent Power (Production)
Temporary Power (Drilling)

Primary Disconnect
Conduit to Underground Cable
25 kV to 4.16 kV Transformer
Primary Metering Unit
Primary Disconnect
Electrical Equipment Costs

**Initial Drilling Rig Equipment Purchases**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Transformer Skid</td>
<td>$180,000</td>
</tr>
<tr>
<td>Voltage Regulator Skid</td>
<td>$110,000</td>
</tr>
<tr>
<td>Harmonic Filter Skid</td>
<td>$100,000</td>
</tr>
<tr>
<td>Electrical Wiring</td>
<td>$ 20,000</td>
</tr>
<tr>
<td>Primary Disconnect</td>
<td>$ 10,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$420,000 per rig</strong></td>
</tr>
</tbody>
</table>

Economic Evaluation

**Fuel Savings**

- **Diesel Cost** (1,600 gallons per day $4.00 per gallon) $6,400 per day
- **Electricity Cost** $2,700 per day
- **Daily Fuel Savings** $3,700 per day
- **25 Day Well Fuel Savings** $92,500 per well
- **Total Electrical Installation – Pad Site** $25,000 per well (assuming 3 wells per pad)
- **Savings on a 25 day well:** $67,500 per well @ $4.00 per gallon
  - $35,000 per well @ $3.00 per gallon

**Break-Even Economic Diesel Price:** $1.65 per gallon
Electricity Continuous Improvement

- Reduce interaction with utility company
- Change from secondary to primary power
- Make incoming voltage more flexible
- Reduce equipment

Improved Design

- Replaces 6 pieces of equipment with one skid
- Capable of connecting to any utility voltage
- Capable of connecting to majority of diesel-electric drilling rigs
Conclusions

- Environmental benefits (emissions and noise)
- Economic benefits
- Logistics are difficult
- Electricity fulfilled drilling requirements at DFW Airport
Could this be the future?