Hot Topics

In
Well
Permitting
CASING REQUIREMENT
BURST PRESSURE EXAMPLE

Intermediate 9 5/8” Casing
36 #/ft, K-55, BTC

Barlow’s Formula

Burst Pressure = \( 0.875(2)(Y)(t)/D \)

\[ P_b = 0.875(2)(55,000)(0.352 \text{ in.})/9.625 \text{ in.} \]

\[ P_b = 3520 \text{ PSI} \]
Associated Pressure of the Marcellus at 6918 feet is 4500 PSI
<table>
<thead>
<tr>
<th>Formations &amp; Csg Points</th>
<th>Depth, ft</th>
<th>Form. Temp. (F)</th>
<th>Pore Press. (EMW)</th>
<th>Frac Gradient (EMW)</th>
<th>Planned MW</th>
<th>Measure Depth</th>
<th>Program</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conductor</strong></td>
<td>120</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>120</td>
<td>20° Conductor</td>
<td></td>
</tr>
<tr>
<td><strong>Casing Point</strong></td>
<td>550</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>550</td>
<td>17 1/2° Surface</td>
<td></td>
</tr>
<tr>
<td><strong>Big Lime</strong></td>
<td>2.057</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.6</td>
<td>FIT/LOT: 14.0 ppg EMW</td>
<td></td>
</tr>
<tr>
<td><strong>Big Injun (Base)</strong></td>
<td>2.512</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.6</td>
<td>12 1/4° Intermediate</td>
<td></td>
</tr>
<tr>
<td><strong>Berea Sand</strong></td>
<td>2.705</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.6</td>
<td>12.8 ppg, BondCem gas tight, single slurry tail design to surface</td>
<td></td>
</tr>
</tbody>
</table>

**Profile:** Vertical
**Bit Type:** 17-1/2" Hammer bit
**BHA:** Air/Mist
**Surveys:** n/a
**Logging:** n/a
**Casing:** 13.375in 54.5 # J-55 BTC set @ ~ 550 MD/550 TVD
**Centralizers:** 1 centralizer w/ stop collar 10 ft above float shoe. One Single Bow every joint to 100ft below surface.
**Cement:** 15.8 ppg BondCem gas tight single slurry tail design to surface

**Potential Drilling Problems:**
- Slow ROP, DBR bit matrix

**FIT/LOT:**
- 14.0 ppg EMW
- Nudge and hold for anticollision
- PDC 7-blade, 16mm cutters; Smith MDS/716
- 8° Directional Assy 6.7 Lobe 4.0 Stg 0.17 rpg, 620 DIFF
- SBM
- Gyro MS, MWD EM Pulse
- n/a
- 9.625in 36#/J55 BTC set at 2800MD/2800TVD
- n/a
- 1 centek centralizer w/ stop collar 10 ft above float shoe. 1 centek centralizer w/ stop collar 10 ft above float collar. 1 centralizer every joint for the first 15 joints. One centralizer every 3 joints to 100ft below surface.
- 15.8 ppg, BondCem gas tight, single slurry tail design to surface
<table>
<thead>
<tr>
<th>Interval</th>
<th>Depth 1</th>
<th>Depth 2</th>
<th>Depth 3</th>
<th>Depth 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordon Sand</td>
<td>2,944</td>
<td>2,944</td>
<td>-1,727</td>
<td>8.6</td>
</tr>
<tr>
<td>Riley</td>
<td>4,804</td>
<td>4,804</td>
<td>-3,587</td>
<td>8.6</td>
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<tr>
<td>Geneseo</td>
<td>6,823</td>
<td>-5,606</td>
<td>145</td>
<td>9.5</td>
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<tr>
<td>Tully</td>
<td>6,848</td>
<td>-5,631</td>
<td>150</td>
<td>9.5</td>
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<tr>
<td>Marcellus</td>
<td>6,918</td>
<td>-5,701</td>
<td>150</td>
<td>9.5</td>
</tr>
<tr>
<td>Onondaga</td>
<td>7,000</td>
<td>-5,783</td>
<td>155</td>
<td>9.5</td>
</tr>
</tbody>
</table>

**Profile:** Vertical Pilot Hole

**Bit Type:** 8 1/2" Security FXD65 (vert)

**BHA:** Directional Assembly (Steerable Motor) + EM w/ GR

**Mud:** SBM

**Surveys:** MWD EM Pulse

**Logging:** Whole core across Marcellus target interval + Quad Combo WL Log

**Casing/Liner:** n/a

**Csg Hanger:** n/a

**Centralizers:** n/a

**Cement:** Plugback w/ (2) 600ft linear plugs to approximately 5800'nd

**Potential Drilling Problems:**

**Notes / Comments:**
Maximum Surface Pressure

- $P_{\text{smax}} = \text{Maximum BHP} - (\text{Gas gradient} \times \text{TVD})$

- $P_{\text{smax}} = (0.6505 \text{ psi/ft} \times \text{TVD}) - (\text{Gas gradient} \times \text{TVD})$

- $P_{\text{smax}} = (0.6505 \times 6930) - (0.1 \times 6930)$

- $P_{\text{smax}} = 4508 \text{ psi} - 693 \text{ psi}$

- $P_{\text{smax}} = 3815 \text{ psi}$
Maximum Anticipated Surface Pressure Based on Leak Off Test

- LOT indicates the formation under the 9 5/8” shoe fractures at an equivalent mud weight of 15 ppg.
- $P_{frac} = (15 \text{ ppg } \times 0.052 \times 2850 \text{ ft})$
- $P_{frac} = 2223 \text{ psi}$
- $\text{MASP} = P_{frac} - (0.1 \text{ psi/ft } \times 2850 \text{ ft})$
- $\text{MASP} = 2223 \text{ psi} - 285 \text{ psi}$
- $\text{MASP} = 1938 \text{ psi}$
Burst Pressure Safety Factor is 20%
\[ 1938_{\text{mosp}} \times 1.20 = 2326 \text{ PSI} \]
Burst Pressure rating of 3520 psi is greater than 2326 psi.
Additional Well Safety for Pad Drilling

• Anti Collision Protocol (Required)

• Deep Set Plugs on Surrounding Completed Wells
Permit Conditions Addressing Water Well or Natural Spring Testing Allowed by WV Code 22-6-11

- 35 CSR 4 -19.1.a
- 35 CSR 4 -19.1.c
• At the request of the surface owner all water wells or springs within 1000 feet of the proposed well that are actually utilized for human consumption, domestic animals or other general use shall be sampled and analyzed.
If the operator is unable to sample and analyze any water well or spring within one thousand (1,000) feet of the permitted well location, the Office of Oil and Gas requires the operator to sample, at a minimum, one water well or spring located between one thousand (1,000) feet and two thousand (2,000) feet of the permitted well location.
Water Testing Parameters for 22-6 Wells (Not H6A)

1. pH
2. Iron
3. Total Dissolved Solids
4. Chloride
5. Detergents (MBAS)
6. Any other parameters determined by operator