Automated Well Control in MPD

Blaine Dow – Drilling Engineering, Marketing and Technology Manager, DPM
The difference in downhole pressure between dynamic and static conditions and its relevance to operating window defines if the wells can be drilled conventionally.
Using MPD it is possible to use a combination of hydrostatic + surface backpressure to overcome the narrow drilling window limitation – and operate within the available drilling window.
Diverting Nuisance Gas

Operational Complexity  Engineering Detail

- Gas Circulation  - Conventional
- Flow Drilling  - Equipment Sizing
- Kick Detection  - Equipment Layout Design
- Formation Assessment  - MPD Program
- HPHT Narrow MW  - Detailed MPD Process Engineering

TIER 1
Managing Narrow Window Drilling

Operational Complexity

- Gas Circulation
- Flow Drilling
- Kick Detection
- Formation Assessment
- HPHT Narrow MW

Engineering Detail

- Conventional
- Equipment Sizing
- Equipment Layout Design
- MPD Program
- Detailed MPD Process Engineering
Compelling Questions to address:

Question 1: Can we automate MPD and Well Control?
Question 2: What barriers currently exist?
Question 3: How do we remove the barriers?
Field Example: Adaptive Pressure Control – MPD / Flow Drilling

- High Pressure RCD
- Choke Manifold
- Flow Meter
- Mud Gas Separator
- Gas Flow Meter
- Backpressure Pump
Automated MPD Well Control Event

Influx detected, backpressure applied

Influx growing, more backpressure applied
Automated MPD Well Control Event (continued)

Heavy weight rollover initiated while drilling resumes

Last bit of gas passes at surface, Influx managed
Industry Barriers to Automated MPD Well Control

<table>
<thead>
<tr>
<th>Category</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment: pressure and volume</td>
<td>No issues</td>
</tr>
<tr>
<td>Technology: detection and control</td>
<td>No issues</td>
</tr>
<tr>
<td>Regulations</td>
<td>Outstanding</td>
</tr>
<tr>
<td>Liabilities: Drilling contractor and service provider</td>
<td>Outstanding</td>
</tr>
<tr>
<td>Legacy: Roles and responsibilities</td>
<td>Outstanding</td>
</tr>
</tbody>
</table>
## Well Control in MPD

### MPD Operations Matrix Standard

<table>
<thead>
<tr>
<th>MPD Operations Matrix</th>
<th>Surface Pressure Indicator Defined by MODP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At Planned Drilling Back Pressure</td>
</tr>
<tr>
<td>No Influx</td>
<td>Continue Drilling</td>
</tr>
<tr>
<td>≤ Operating Limit</td>
<td>Continue drilling, adjust system to increase BHP</td>
</tr>
<tr>
<td>&gt; Operating Limit</td>
<td>Secure well, evaluate next planned action</td>
</tr>
</tbody>
</table>

- **Optimum parameters for MPD Operations**
- **Continue MPD Operations with caution while the influx is confirmed**
- **Influx confirmed. MPD Operations must be stopped and the well secured to evaluate next action**
MPD and Well Control – Real life

- HPHT Exploration well, offshore jackup

- Automated MPD system using flow metering to monitor for influx and loss – navigate PP ramp

- All necessary pre-planning, and Well control matrix in place

- The story……

- interpretation of roles and responsibilities was left to be discovered during a live event.

- Ref: SPE 143099, SPE 163546
MPD and Well Control – Future State

• Automation of the process Highly likely to improve outcome
  • Desire of several operators
  • Logical

• Dependencies:
  • Integrated control of MPD equipment and Rig equipment
  • Data: quality, frequency, control
  • Liability agreement
Compelling Questions to address:

Question 4: Should we automate MPD and Well Control?

Yes!
Thank you