"Sharing To Be Better"

Swabbed kick from shallow reservoir in exploration well
Status prior to POOH with drilling BHA;

- 9 5/8” casing set and cemented at 767 m MD/TVD with hanger at 469 m.
- FIT on 9 5/8” shoe was performed to 1.45 sg EMW.
- Well filled with 1.17 sg WBM.
- 8 ½” hole section was drilled to TD at 1594 m.
- Several potential hydrocarbon bearing formations exposed in open hole.
- Plan forward was to POOH with drilling BHA (BHA length 274 m) and perform WL logging.

Question 1: Can you identify any risks or potential problems?
Incident Summary:

- Drilled and cored 8 ½” hole section from 767 m to TD at 1594 m.
- Back-ream out of hole and into 9 5/8” casing shoe due to over-pull when pulling without circulation.
- Performed flow-check in shoe (767 m MD/TVD) and continued to trip out of hole.
- Observed rapid increase in trip tank at 531 m.
- Shut in well on LAP and evaluate situation.
- Performed off-bottom kill and circulate out gas.

Question 2: What do you think happened?
Incident details - Drill to TD:

- Drilled 8 ½” hole section from 9 5/8” casing shoe at 767 m to TD at 1594 m.
  - Cored three intervals from 800 – 827 m, 834 – 889 m and 889 – 935 m.
  - Drilled section with 1.17 – 1.18 sg WBM.
  - Gas reading were generally less than 1% during drilling. Max gas during coring was 17%.

- Circulated bottoms up at TD and performed flow check prior to POOH.

- Took weight when attempting to POOH and started back-reaming out of hole.
  - Stopped several times and attempted straight pull, but experienced over-pull every time.
  - Decided to back ream from TD to 9 5/8” casing shoe with 1700 LPM.

- Pulled BHA into casing shoe and performed flow check.
Geological hazards

- Possible boulders
- Shallow Gas Class 1
- Reservoir sandstone, possible influx of hydrocarbons
- Interbedded Sand and Shale:
  - Possible washouts or ledges
Analysis prior to POOH

- Performed swab calculations prior to POOH.
  - Well was filled with 1.17 sg WBM (1.16 sg used in calculations).
  - Predicted pore pressure in shallow reservoir at 823 m was 1.11 sg.
  - 2 points safety margin included in swab calculations.

Question 3: Is this safety margin ok (based on TVD)?

<table>
<thead>
<tr>
<th>Input Data</th>
<th>Trip Details</th>
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<tbody>
<tr>
<td>Mud Properties</td>
<td></td>
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<tr>
<td>Density</td>
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<tr>
<td>Mud Type</td>
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<td>FANN Rheology</td>
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<td></td>
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<td>10 min Gel</td>
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<td>Bit Details</td>
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<td>Size</td>
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<td>Bit Status</td>
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<td>Fracture Depth</td>
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<td>Formation Press.</td>
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<tr>
<td>Formation Depth</td>
<td>828.00 m</td>
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<tr>
<td>Safety Margin Swab Gel strength is broken prior to Tripping</td>
<td>0.020 sg</td>
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Analysis prior to POOH

- The swab calculations show that maximum pulling speed at casing shoe was 120 sec/stand.
- Limited pulling speed (132 sec/stand) past reservoir.

**Question 4:** Are these valid once the bit is inside casing?
Pull out of hole inside casing:

- Pumped slug and started tripping out of hole from casing shoe.
  - Pumped 3 m³ 1.46 sg slug.
  - Swab calculations and pulling speed restrictions not discussed prior to continue POOH.
- Noticed discrepancy in trip tank volume, but this was attributed to the slug not being in balance.
  - Pulled two more stands and trip tank was still not taking correct volume.
  - Driller discussed with tool pusher and decided to pull one more stand very slowly to verify slug effect.
- While breaking connection on the next stand (bit @ 531 m) there was a rapid gain of 5 m³ in the trip tank.
  - Shut in well with the lower annular preventer (LAP) on 6 ¾” spiral DC.
  - Secured drill string by making up top drive and lifting string out of slips.

Question 5: What could have been done differently?
Question 6: Do we need to pump slug in this situation?
**Incident time log:**

<table>
<thead>
<tr>
<th>HK Height [AVG: 7.6]</th>
<th>WOH [AVG: 7.6]</th>
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<tbody>
<tr>
<td>-5 (m) 45 (tonne) 150</td>
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<table>
<thead>
<tr>
<th>Downhole RPM</th>
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<tr>
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<table>
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<tr>
<th>Cont. Inc.</th>
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<tbody>
<tr>
<td>0 (dega) 100</td>
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<table>
<thead>
<tr>
<th>Trip Tank - Out</th>
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</thead>
<tbody>
<tr>
<td>0 (m3) 20</td>
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</table>

65 sec
126 sec
58 sec
26 sec
33 sec
26 sec
39 sec

Possible combination of gain and slug

5 m3 gain
Shut in well:

- Well shut in with LAP on 6 ¾" DC.
- Gain volume = 5,6 m3.
- SICP = 25,5 bar and SIDPP = 16 bar (after bumping float).
- Jar and accelerator part of the BHA above the closed LAP – stripping not an option.
- Well gas-filled from 658 m to LAP.
  - Based on gain in active system.
- Pressure at shoe = ~1.27 sg EMW
- Choke line pressure increased to 45 bar after bleeding off 800 liter – gas in choke line.
- FIT: 1,45 sg

Question 7: Any thoughts or comments to this situation?
Well Kill Operation:

- Circulated hydrocarbons out through choke with 460 LPM while keeping constant back-pressure on kill line.

- Completed five rounds of circulation. Observed erratic returns and large volumes of gas going through the poor-boy degasser.

- Very difficult to calculate maximum pressure at shoe due to unknown mud level.
  - Shoe pressure at shut-in: ~1,32 sg
  - Max estimated shoe pressure: ~1,41 sg
  - FIT: 1,45 sg
Critical issues:

- Gas filled well with bit ~300 m above most likely gain zone.
- Well successfully closed in with annular preventer on spiral drill collar.
- At the time the well was closed in it was uncertain whether the blind shear ram could shear and seal drill collar.
- Unable to strip in hole due to jar located above upper annular preventer.

Lessons Learned:

- Surge / Swab calculations are still valid when tripping in cased hole.
- Low pressure margins when dealing with shallow reservoirs.
  - 6 points (1,17 MW vs. Est PP of 1,11 sg) overbalance at 823 m is only 4,8 bar
- Small margins when circulating out an influx with a shallow casing shoe.
  - SICP of 25 bar equals 1,51 sg. – Estimated frac at casing shoe.
  - SICP of 18 bar equals 1,41 sg. – Max pressure at casing shoe.
- Perform flow check and circulate bottoms up if indications of gain.

Question 8: Any other lessons learned?