

# Intervention based cementing methods for rigless P&A

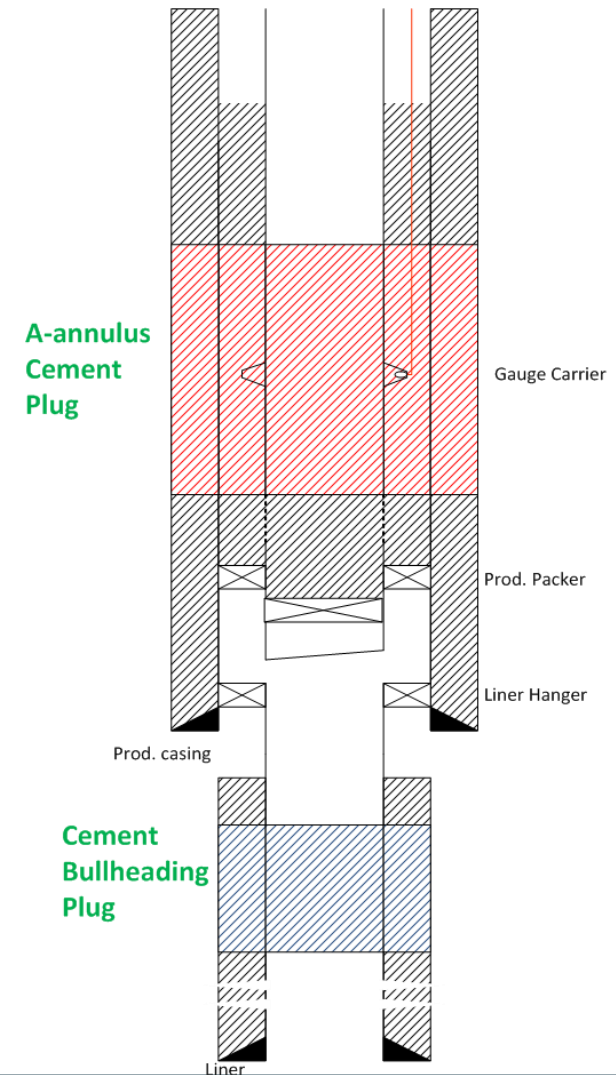
Cement Bullheading & A-annulus cementing

# AGENDA

- Cement Bullheading and A-annulus Cementing, what do we mean?
- Tailored wiper design
- Piloting Cement Bullheading:
  - Method for establishing PP&A cement plug in liner
  - Verification of cement bullheading plugs
- Piloting A-annulus cementing
  - A-annulus cementing with integrated (as-is) control lines/cables
  - A-annulus cementing with integrated (punched/cut) control lines/cables
  - Verification of A-annulus cement plugs
- Opportunities for improved business case for A-annulus cementing

# Cement bullheading and A-annulus cementing – what do we mean?

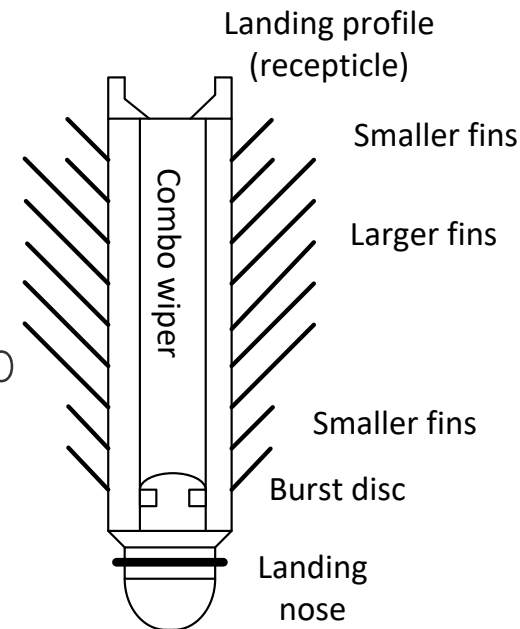
- Cement bullheading PP&A plug
  - *Cement placed in cemented liner on an established fundament, by bullheading the cement through the XMT and the production tubing down to the fundament in the liner.*
- A-annulus cementing PP&A plug
  - *Cement placed in A-annulus and tubing, by circulating cement through the XMT, down the tubing and into the into the A-annulus. The tubing and A-annulus cement is placed on top of a present/established fundament.*



## Tailored wiper design

### Halliburton modular wiper concept\*

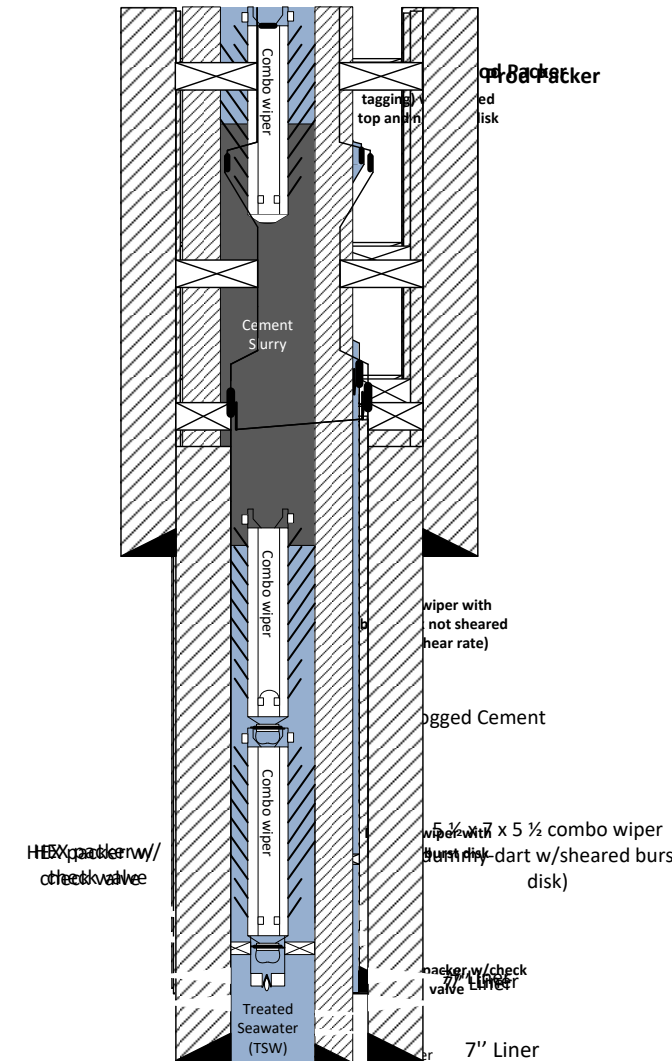
- Relevant for both cement bullheading and A-annulus cementing
- Currently tested for wiping +/- 4.8" up to 7" completion ID
- Pass-through test in 4.5" restriction
- Work in progress to allow for wiping from 4.5" tubing up to 10 3/4" and casing to allow for passing +/- 3.8" restrictions
- Integrated burst discs (flexibility in burst pressure)
- Option for fishing of wiper (Wireline)
- Handles SPM's
- Stackable with high-pressure sealing capability
- Special version for spear tagging of PP&A plug



\*Testing still ongoing

# Method for establishing PP&A cement plug in liner with cement bullheading

1. Rig up cement spool on top of XMT with WL stack on top of cement head
2. Confirm injectivity, clean well and fill with Treated Seawater / brine
3. Optional: Drift well (to verify mechanical access)
4. Log liner cement (USIT/CBL)
5. Set packer with integrated check valve and test packer/CV
6. Bullhead dummy wiper (with TSW) and land on top of packer
7. Shear burst disk and perform fingerprinting through sheared dummy and packer
8. Install lower and upper dart in cement spool
9. Bullhead spacer, lower wiper, cement, upper wiper and spacer and land lower wiper on top of dummy wiper
10. Wait on cement



# Possible verification plan for cement bullhead plugs

1. Tag top of cement with fit-for-purpose designed spear (Altus Intervention) run on wireline stroker\*

- Obtain solid tag with good cement either on top or below upper wiper
- Designed for 1 ton tag force (comparable to 10 ton DP tag)
- Centralizers pinned to spear body for entering wiper
- Pencil shaped spear tip
- Robustness in verification from depth accuracy and repeatability (re-tag)
- Functionality proven from onshore testing

\*DP tag and dressing required in pilot phase

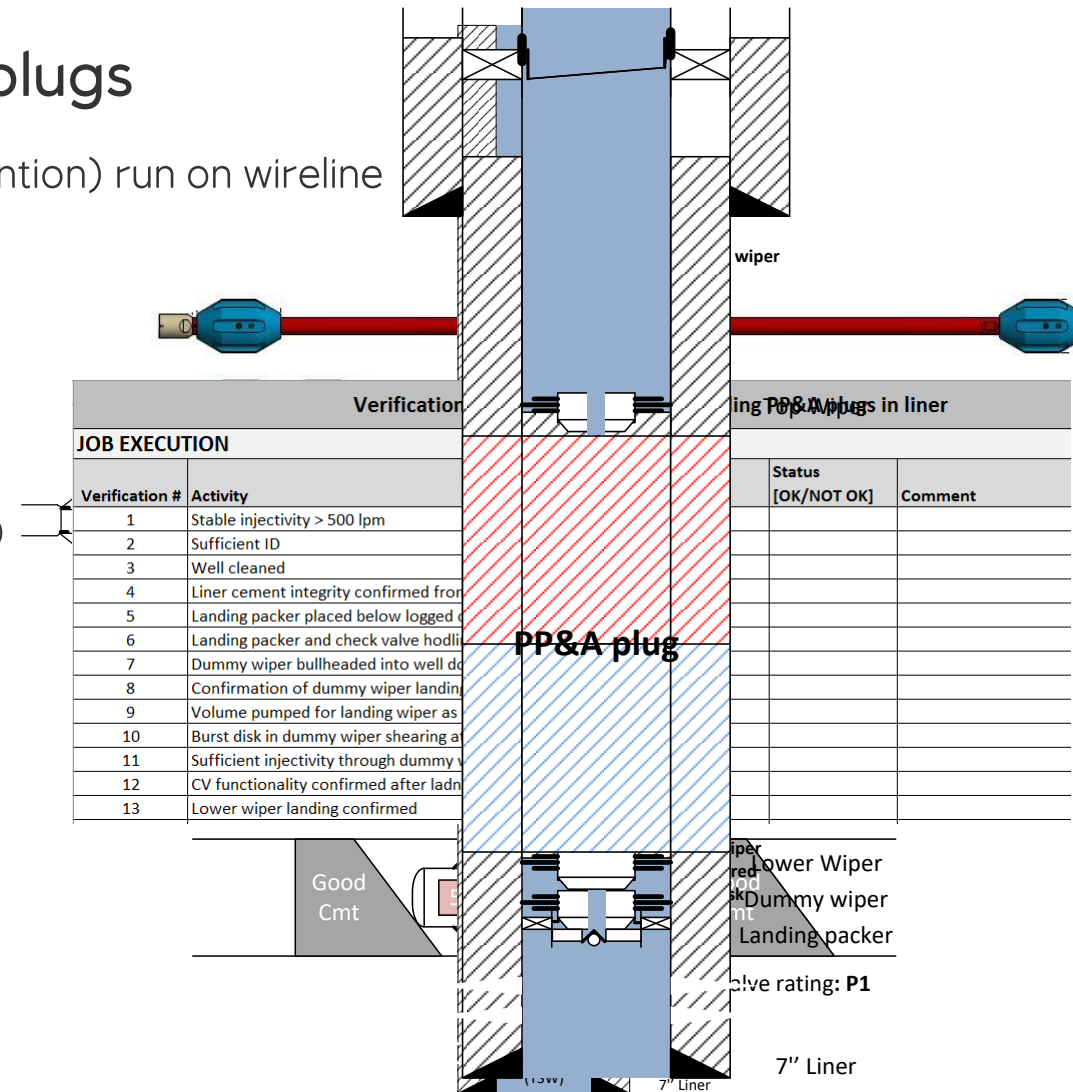
2. Leak test cement plug

- Leak test to pressure P3 > P2 (burst disc rating) & P1 (check valve rating)

3. Verification matrix

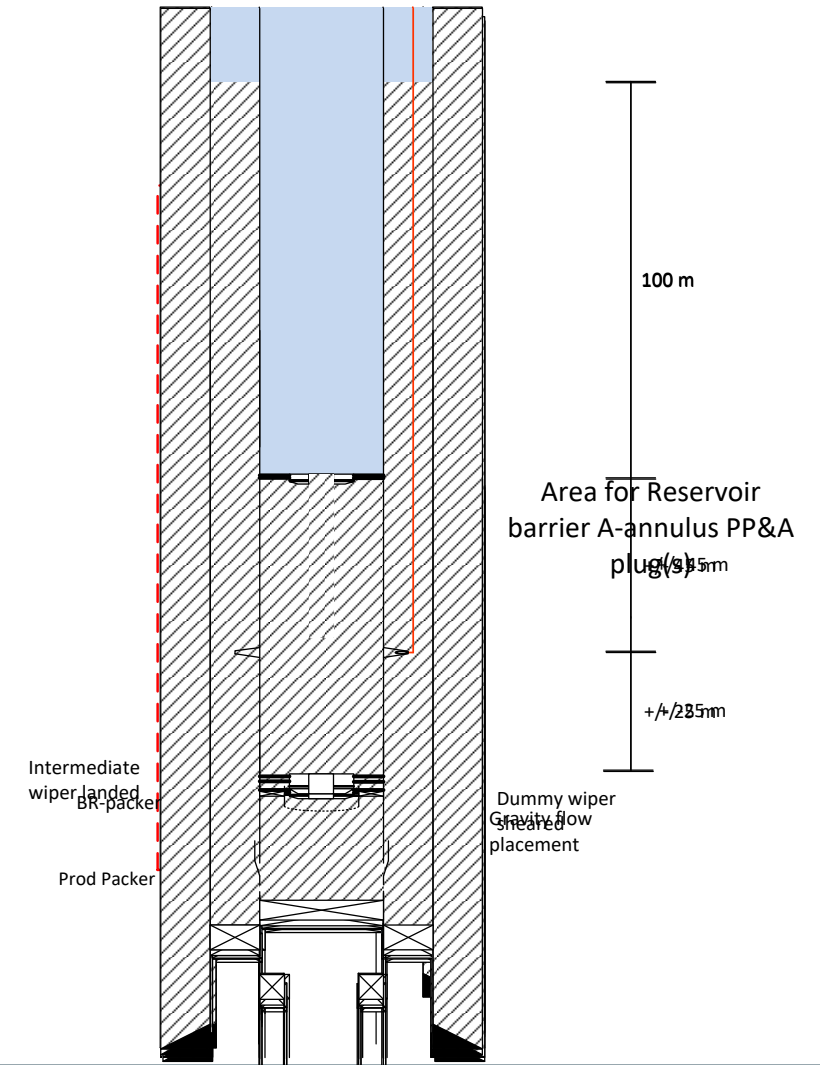
Equinor target (after piloting):

*Limited need for DP tag and dressing for verification of cement bullheading PP&A plugs*



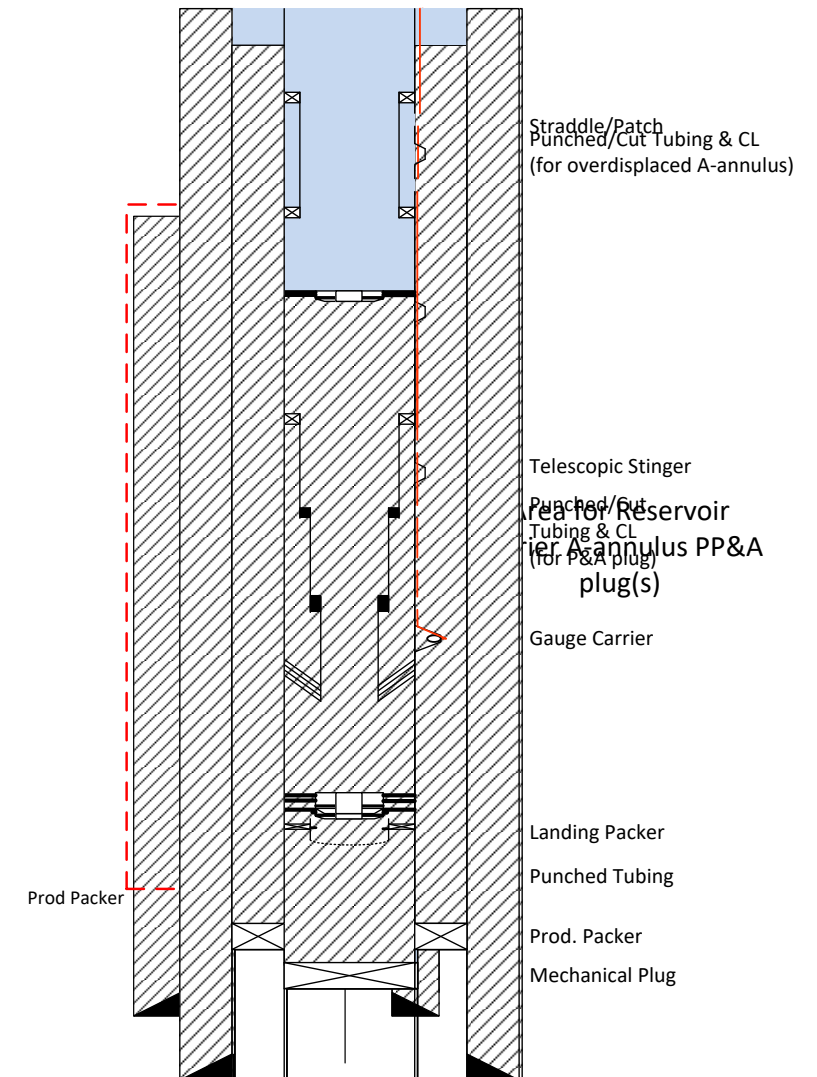
# A-annulus cementing option#1: Establish PP&A cement plug with integrated (as is) control lines (pilot phase)

- PP&A cement plug established as follows:
  - For wells with hydraulic control line(s) at depth of PP&A plug, fill line with sealing material from surface
  - Mechanical plug, punch tubing (as close to prod. packer as possible) and circulate "clean"
  - Landing packer for cement wipers placed above punched holes
  - Dummy wiper bullheaded, landed on base and sheared
  - Cement «train» with lower, intermediate and upper wiper (high rate)
  - Land lower wiper on top of dummy wiper, shear and reduce rate (low rate) for gravity placement of cement
  - Intermediate wiper lands resulting in overdisplaced A-annulus
  - Wait on cement



## A-annulus cementing option#2: Establish PP&A cement plug with integrated (punched/cut) control lines (pilot phase)

- PP&A cement plug established as follows:
  - For wells with hydraulic control line(s) at depth of PP&A plug, fill line with sealing material from surface
  - Mechanical plug, punch tubing (as close to prod. packer as possible) and circulate "clean"
  - Punch/cut tubing (sectors) to cut CL(s) (two cut zones in pilot phase), and place landing packer
  - Verify CL(s) cut (logging)
  - Set telescopic cement stinger and/or straddle across cut zones
  - Place cement in tubing and A-annulus with overdisplaced A-annulus (similar procedure as for option#1) and wait on cement



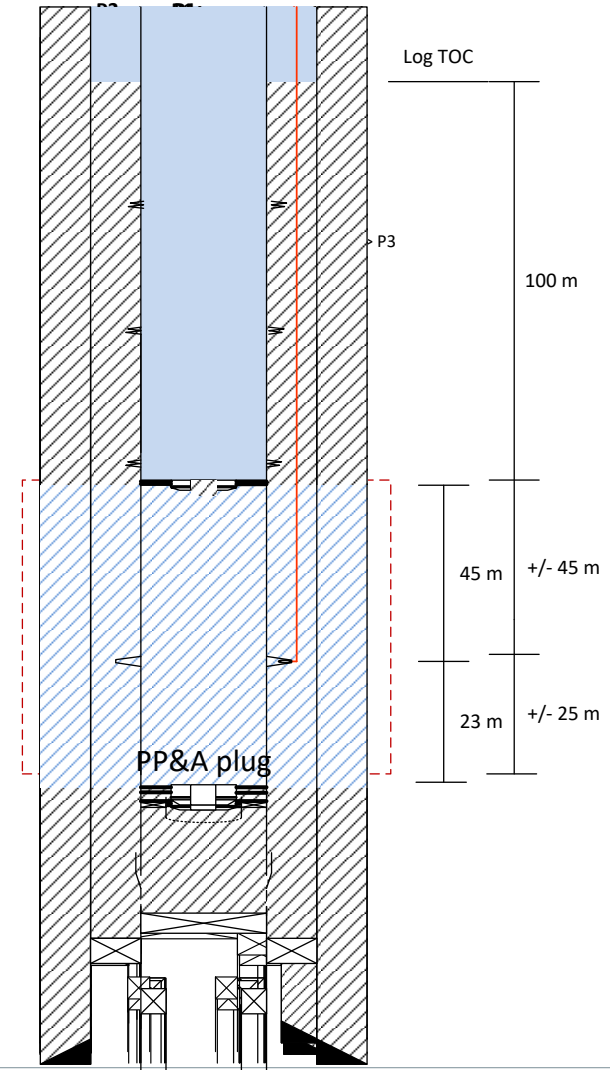


# Verify A-annulus PP&A cement plug (pilot phase)

- Pilot method highly focus on proper verification
- Same verification principle for option#1 & #2
- Use «worst-case» over-displaced A-annulus cement for verification
- Good integrity proven for over-displaced cement = good integrity of cement in A-annulus for PP&A plug
- Verification plan:
  - Log TOC in A-annulus (to confirm volume control)
  - Tag TOC in tubing with WL stoker & spear
  - Sequential punching and inflow testing
  - Leak test lower punch interval (optionally high diff. pressure)
- Cement integrity of the PP&A plug verified!

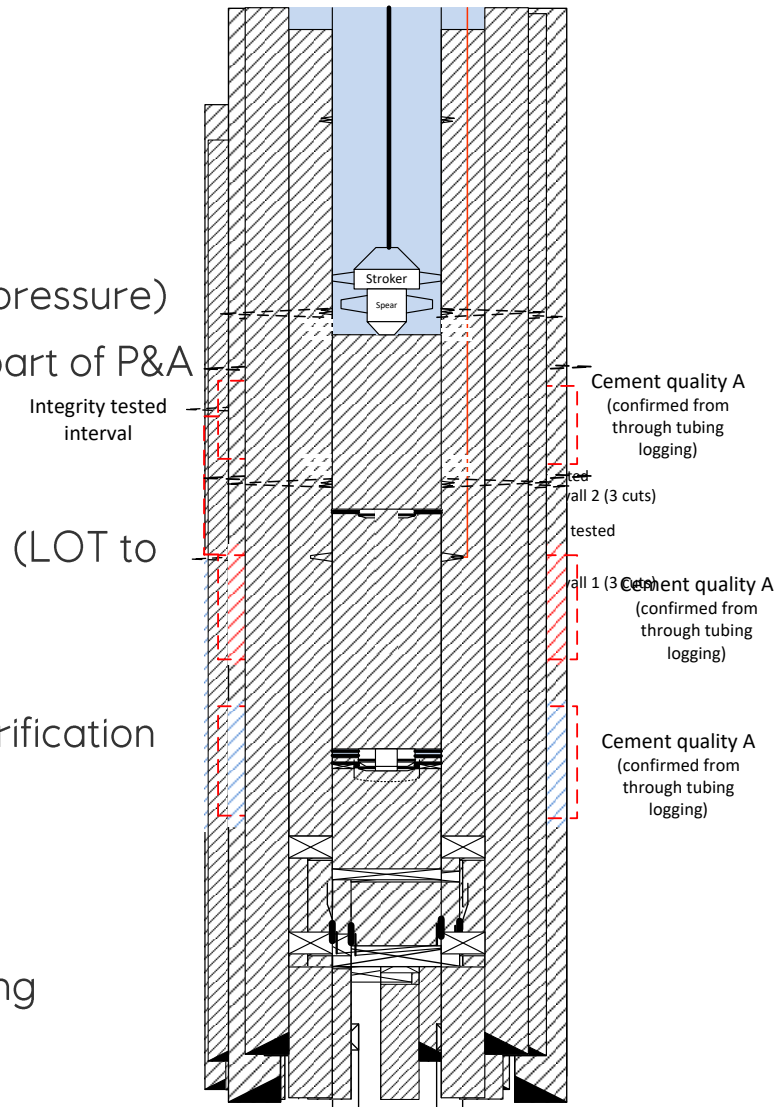
## NOTE:

- Many (time consuming) verifications planned in pilot phase.
- Target to reduce amount of verifications after successful piloting



# Some opportunities for improved business case for the A-annulus cementing method

1. *Leaving control cable/control line integrated as part of PP&A plug – HOW?*
  1. Cut tubing and cemented A-annulus w/CL using mechanical WL cutter
  2. 2-3 cuts at bottom and top of interval to be tested (to ensure CL cut)
  3. Leak test cemented A-annulus between cuts interval (optionally with high diff. pressure)
  4. Good test from overdisplaced A.annulus -> acceptable with CL integrated as part of P&A plug below
2. *Verify integrity of cement and/or collapsed shale behind prod. casing – HOW?*
  1. Perforate bottom and top of interval for PP&A plug in overdisplaced A-annulus (LOT to confirm communication)
  2. Leak test interval between perforations (optionally with high diff. pressure)
  3. If available, use through-tubing logging data in combination with leaktest as verification of B-annulus
  4. A-annulus cement plugs as combined barrier (primary and secondary)
3. *A-annulus cementing in combination with cement dumping on wireline – HOW?*
  1. Place cement in tubing in area from 1 and/or 2 above , with wireline dump-bailing
  2. Verify integrity of cement with spear tagging



## Summary

- Many complex challenges remains to be investigated and solved for releasing the full potential with Intervention based cementing methods
- Time consuming and costly pilot operations (with failures!) will be required in order to get where we want – are we willing to take the risk/cost?
- Intervention based cementing is just one step out of many, in order to be able perform more safe, efficient and cost effective rigless P&A operations in the future.
- We all need to contribute in order to take the necessary steps moving away from todays dominating rig-based P&A solutions over to the future of P&A which should be rigless 😊

Anyone who want's to join our rigless P&A party? 😊

QUESTIONS?

Intervention based cementing methods for rigless P&A

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