



PWC® as a method for annular remediation

Qualification and verification by design vs. demonstration

POWERED BY INVENTION

Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024



Who are HydraWell?

What is PWC®?

Testing

Verification



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Who are Hydrawell?

What is PWC®?

Testing

Verification

PASSIONATE.

**Establish in 2008
Recognised it was
time for a new
approach to Well
Integrity**

PIONEERING.

**The industry was in
need of a new
approach to replace
cumbersome
traditional methods
for barrier
remediation**

PROBLEM SOLVING.

**Invented
something
quicker, slicker
and safer: PWC®**



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Who are Hydrawell?

What is PWC®?

Testing

Verification



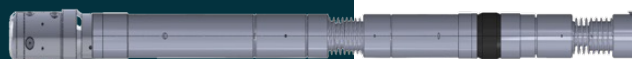
This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

As responsible P&A innovators, our PWC® method for annular remediation has evolved over the years

Who are Hydrawell?



HydraCT™
Coiled Tubing Based



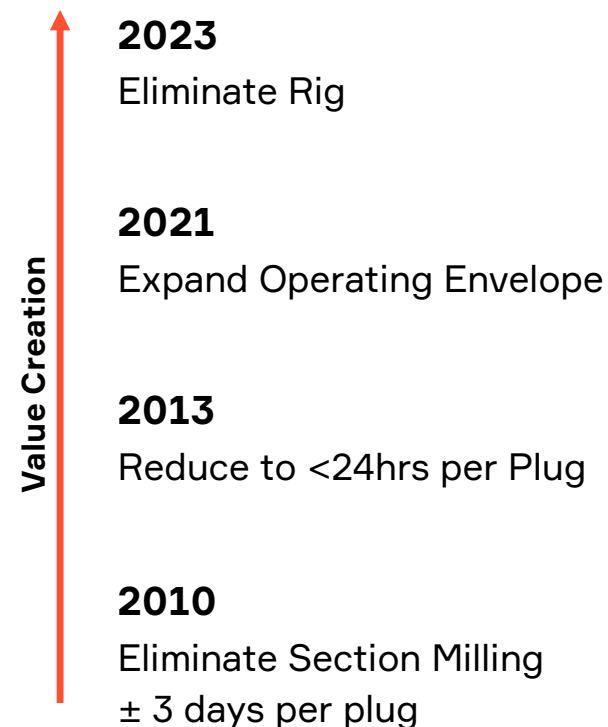
HydraTyphon™
Hybrid Cup + Jet



HydraHemera™
Jet Based System



Hydrawash™
Cup Based System



What is PWC®?

Testing

Verification

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

What is PWC®?

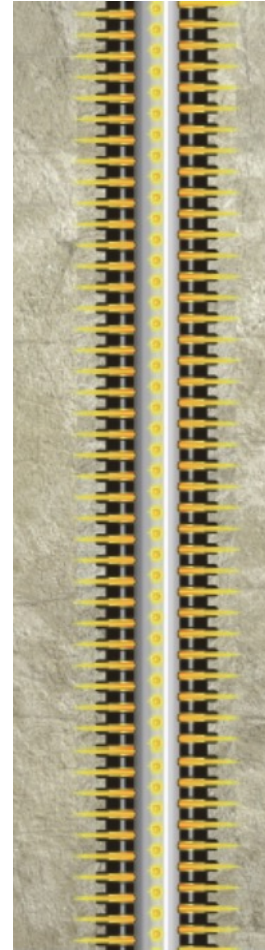
Who are Hydrawell?

Testing

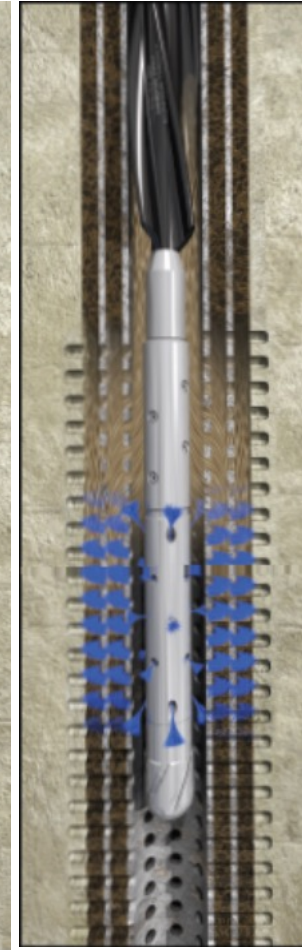
Verification

- Restores annular integrity
- Replacement for Section milling, Perf & Squeeze, Cut & Pull
- First plug installed in 2010.
- 575+ plugs installed
- Typically 1.5-2 days

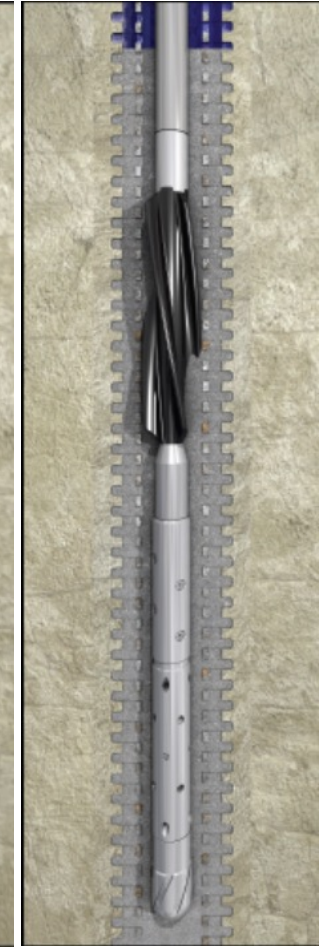
Perf



Wash



Cement



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Testing

- ✓ Yard testing: Removal of annular debris
- ✓ Fullscale SIT
- ✓ CFD modelling
- ✓ Digital Twin

Who are Hydrawell?

What is PWC®?

Verification

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Testing

- ✓ Yard testing: Removal of annular debris
- ✓ Fullscale SIT
- ✓ CFD modelling
- ✓ Digital Twin

Who are Hydrawell?

What is PWC®?

Verification

- 7" casing inside 9-5/8"
- 12" plexi glass simulating open hole
- Filled with barite/cement mix (90/10)
- Washing with 70 liter per nozzle (700 lpm)
- 7" x 9-5/8" annulus was completely cleaned

Washing effect #1:
direct hit



Washing effect #2:
indirect hit



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

Testing

- ✓ Yard testing: Removal of annular debris
- ✓ Fullscale SIT
- ✓ CFD modelling
- ✓ Digital Twin

Who are Hydrawell?

What is PWC®?

Verification



Pre-wash



Post-wash



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Testing

- ✓ Yard testing: Removal of annular debris
- ✓ Fullscale SIT
- ✓ CFD modelling
- ✓ Digital Twin

Who are Hydrawell?

What is PWC®?

Verification



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Testing

- ✓ Yard testing: Removal of annular debris
- ✓ Fullscale SIT
- ✓ CFD modelling
- ✓ Digital Twin

Who are Hydrawell?

What is PWC®?

Verification

#1 – HydraCT™



#2 – HydraHemera™



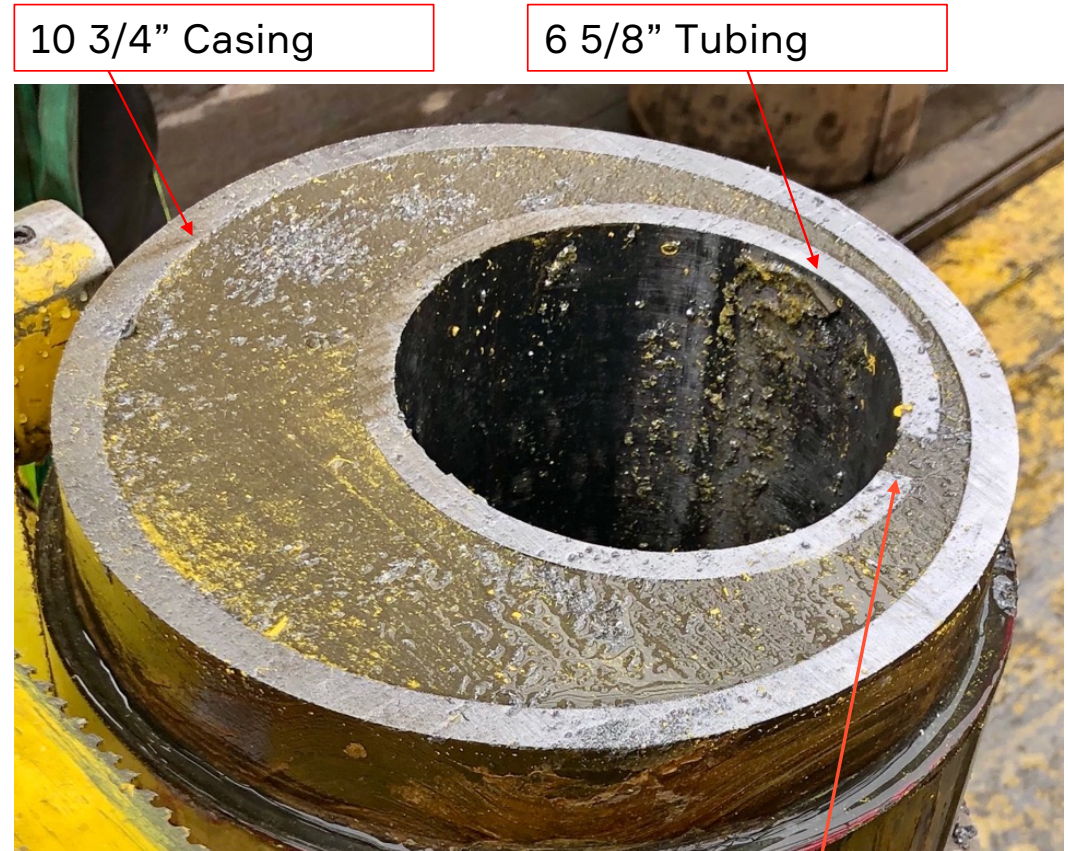
This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

SIT Example #1 – 3.6" SwivelJet HydraCT™ test at Ullrigg (NORCE)

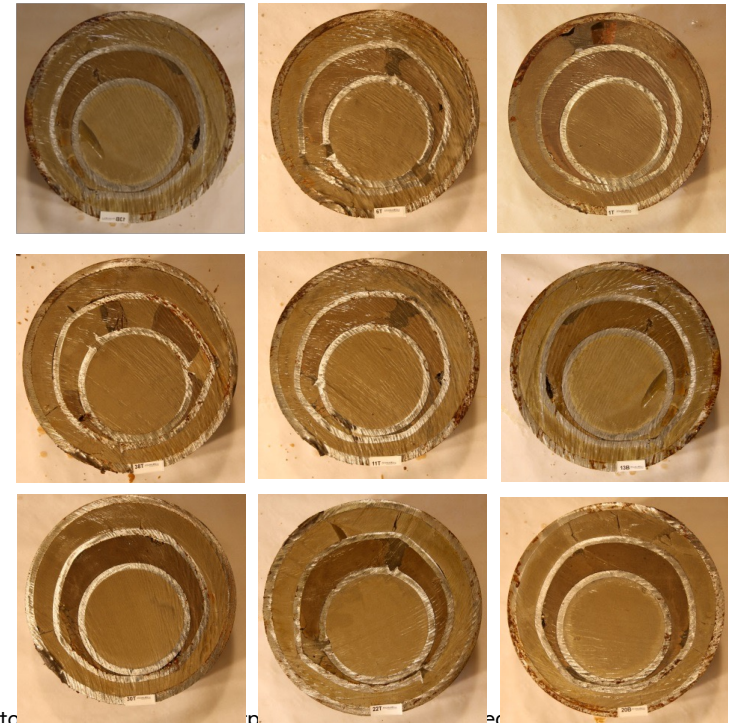
1. Tagged TOC at planned depth
2. Drilled hard cement thru entire cemented interval.
3. Isolation scanner used to log Cement bond, perfect bond.
4. Retrieved and cut joints fully cemented in cross section.



Slot perforation

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

SIT Example #2 – 7" x 9-5/8" Dual Casing full SIT on Ullrig (NORCE)



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Verification

Drill out and log PWC® area

Negative Inflow Test

Computational Fluid Dynamics – Digital Twin

Weight Tag and Pressure Test

PWC® Qualification Matrix

Who are Hydrawell?

What is PWC®?

Testing

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Verification

✓ Drill out and log PWC® area

Computational Fluid Dynamics – Digital Twin

Weight Tag and Pressure Test

PWC® Qualification Matrix

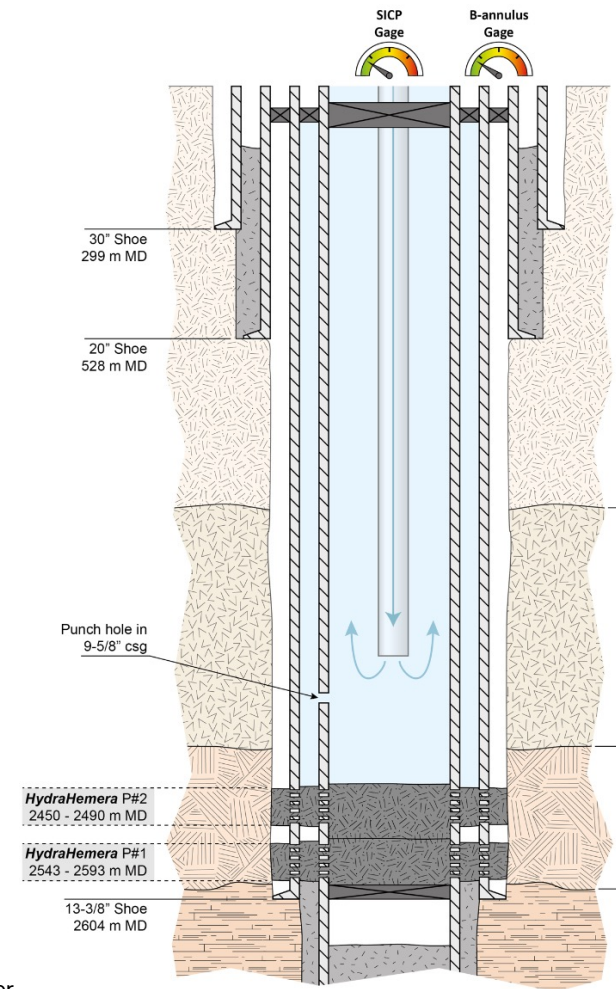
Who are Hydrawell?

What is PWC®?

Testing

Negative Inflow Test

5ea PWC® plugs in dual casing have been negative pressure tested by circulating in a light fluid (e.g., base oil) above the PWC® plug, resulting in ≈ 3500 psi ΔP across the PWC® plug



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

Verification

- ✓ Drill out and log PWC® area
- ✓ Negative Inflow Test

Weight Tag and Pressure Test

PWC® Qualification Matrix

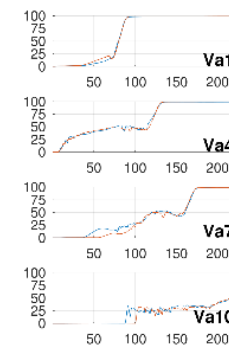
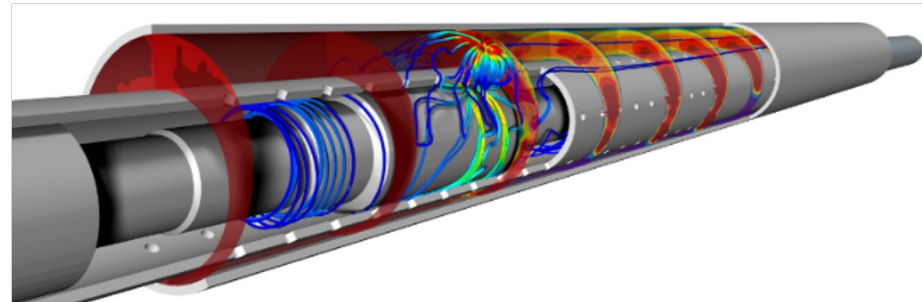
Who are Hydrawell?

What is PWC®?

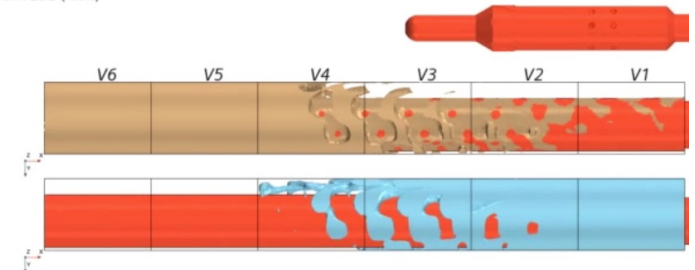
Testing

Computational Fluid Dynamics – Digital Twin

Accurate computer models to predict job outcome



Brown: ANNULUS CONTENT (>95%)
Blue: WASH FLUID (>95%)



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to Solution Time 180,8 (s) for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

Verification

- ✓ Drill out and log PWC® area
- ✓ Negative Inflow Test
- ✓ Computational Fluid Dynamics – Digital Twin

PWC® Qualification Matrix

Who are Hydrawell?

What is PWC®?

Testing

Weight Tag and Pressure Test

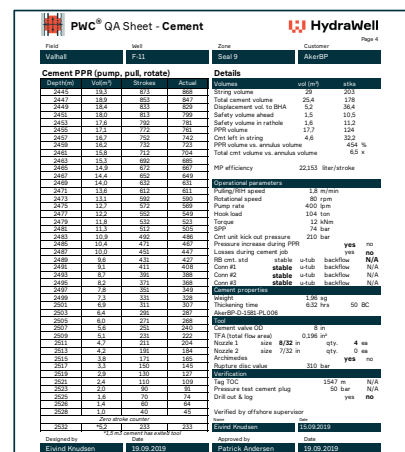
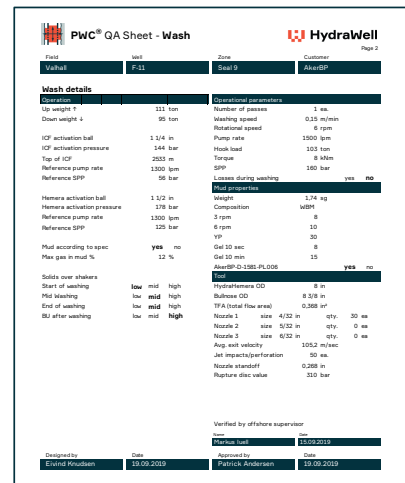
- Common practice for verification that casing cement plugs have set up
- Doesn't tell us anything about the quality of annular cement



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

- ✓ Drill out and log PWC® area
- ✓ Negative Inflow Test
- ✓ Computational Fluid Dynamics – Digital Twin
- ✓ Weight Tag and Pressure Test

- Job design sheet, QA sheet for wash, spacer and cement
- Derived from offset data (track record, logged plugs, CFD)



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024

- ✓ Drill out and log PWC® area
- ✓ Negative Inflow Test
- ✓ Computational Fluid Dynamics – Digital Twin
- ✓ Weight Tag and Pressure Test

- Job design sheet, QA sheet for wash, spacer and cement
- Derived from offset data (track record, logged plugs, CFD)

[illegible]

| | Info | Depth Cmt Vavle | IfO at start | Planned strokes | Actual Strokes | | Info | Depth Cmt Vavle | IfO'd at cmt exit | Planned strokes | Actual Strokes | |
|-----------------------------------|---------------|-----------------|--------------|-----------------|----------------|---------------|------------|-------------------|-------------------|-----------------|----------------|----------|
| | | | | | | | Connection | | | | | |
| PPR Chart ± 10 stks / 20 ft | | 9600ft | | | 1418 stks | □ | | 9693 ft | 441 stks | 961 stks | 961 stks | |
| | Stop Position | 9604 ft | 883 stks | 1403 stks | 1400 stks | | | | | | | |
| | | 9608 ft | 865 stks | 1384 stks | 1372 stks | | | 9694 ft | 437 stks | 956 stks | | |
| | | 9613 ft | 842 stks | 1361 stks | 1351 stks | | | 9699 ft | 414 stks | 933 stks | 933 stks | |
| | | 9618 ft | 818 stks | 1338 stks | 1331 stks | | | 9704 ft | 390 stks | 910 stks | 911 stks | |
| | | 9623 ft | 795 stks | 1315 stks | 1313 stks | | | 9709 ft | 367 stks | 887 stks | 890 stks | |
| | | 9628 ft | 772 stks | 1292 stks | 1291 stks | | | 9714 ft | 344 stks | 864 stks | 868 stks | |
| | | 9633 ft | 749 stks | 1269 stks | 1270 stks | | | 9719 ft | 321 stks | 840 stks | 843 stks | |
| | | 9638 ft | 726 stks | 1245 stks | 1248 stks | | | 9724 ft | 298 stks | 817 stks | 818 stks | |
| | | 9643 ft | 703 stks | 1222 stks | 1226 stks | | | 9729 ft | 275 stks | 794 stks | 792 stks | |
| | | 9648 ft | 679 stks | 1199 stks | 1205 stks | | | 9734 ft | 251 stks | 771 stks | 766 stks | |
| | | 9653 ft | 656 stks | 1176 stks | 1182 stks | | | 9739 ft | 228 stks | 748 stks | 740 stks | |
| | | 9658 ft | 633 stks | 1153 stks | 1165 stks | | | 9744 ft | 205 stks | 725 stks | 714 stks | |
| | | 9663 ft | 610 stks | 1129 stks | 1140 stks | | | 9749 ft | 182 stks | 701 stks | 690 stks | |
| | | 9668 ft | 587 stks | 1106 stks | 1121 stks | | | 9754 ft | 159 stks | 678 stks | 671 stks | |
| | | 9673 ft | 564 stks | 1083 stks | 1092 stks | | | 9759 ft | 136 stks | 655 stks | 650 stks | |
| | | 9678 ft | 540 stks | 1060 stks | 1069 stks | | | 9764 ft | 112 stks | 632 stks | 630 stks | |
| | | 9683 ft | 517 stks | 1037 stks | 1044 stks | | | 9769 ft | 89 stks | 609 stks | 609 stks | |
| | | 9688 ft | 494 stks | 1014 stks | 1020 stks | | | 9774 ft | 66 stks | 586 stks | 588 stks | |
| | | (+) 3 bbls | 9693 ft | 471 stks | 990 stks | | 991 stks | Bottom Perf (PPR) | 9779 ft | 43 stks | 562 stks | 567 stks |
| | | | | | | Stop position | 9784 ft | 20 stks | 539 stks | 539 | | |

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.

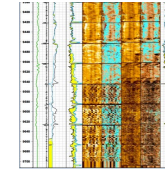
Verification

Who are Hydrawell?

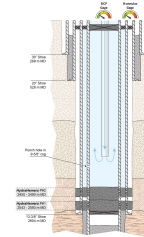
What is PWC®?

Testing

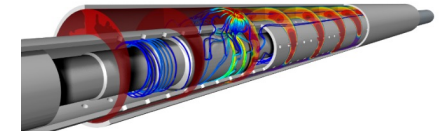
✓ Drill out and log PWC® area



✓ Negative Inflow Test



✓ Computational Fluid Dynamics – Digital Twin



✓ Weight Tag and Pressure Test



✓ PWC® Qualification Matrix

A complex table with multiple columns and rows, likely representing a qualification matrix for PWC. It includes various technical specifications and data points.

This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Who are HydraWell?

What is PWC®?

Testing

Verification



This document contains Confidential Information of Hydra Well Intervention AS (HWI) and is furnished to the customer for information purposes only. It is requested that the document not be reproduced in any way whatsoever, in part or in whole, or distributed outside the customer organization without first obtaining the express written authorization of HWI. This document is the property of HWI and returnable on request of HWI. © 2024, Hydra Well Intervention AS. All rights reserved.



Technical Seminar: Plugging and Abandonment – HAVTIL 7th May 2024



PWC® as a method for annular remediation

Qualification and verification by design vs. demonstration

POWERED BY INVENTION