The Novel Fluid Placement Strategy : Lab to Field Execution for Coiled Tubing Gas Shut-Off in A Highly Deviated Offshore Well

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Outline

- Introduction
- Well Background
- Intervention Objectives
- Novel Shut-Off Strategy and Chemistry Introduction
- Design & Planning
- Execution
- Results & Impact
- Lesson learned Value of temp survey modeling

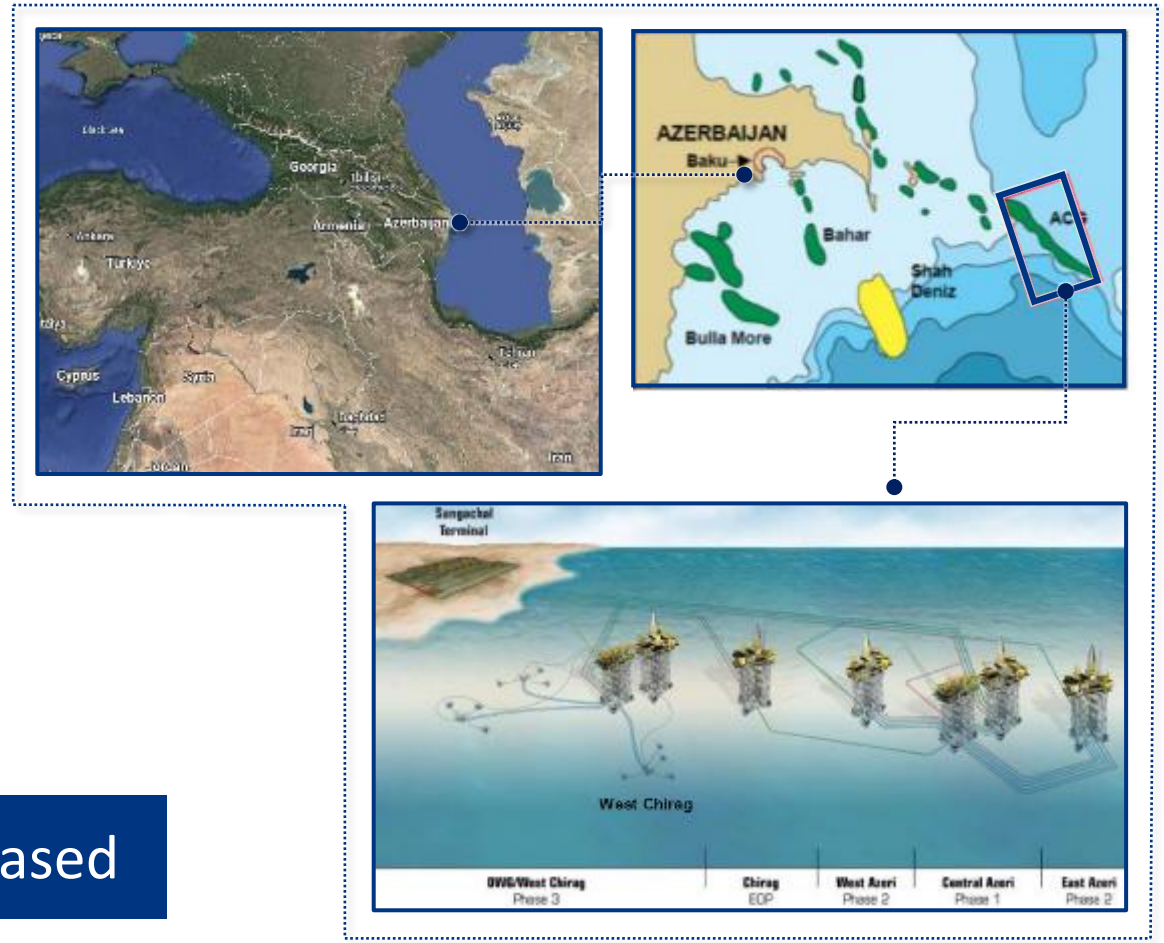
Introduction

Offshore Azerbaijan

Multilayered sandstone

Weakly consolidated (60 to 665 psi UCS)

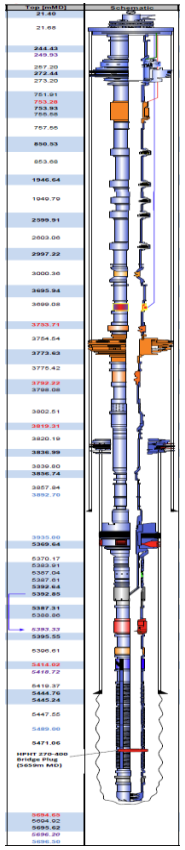
Premature gas breakthrough commonly increased



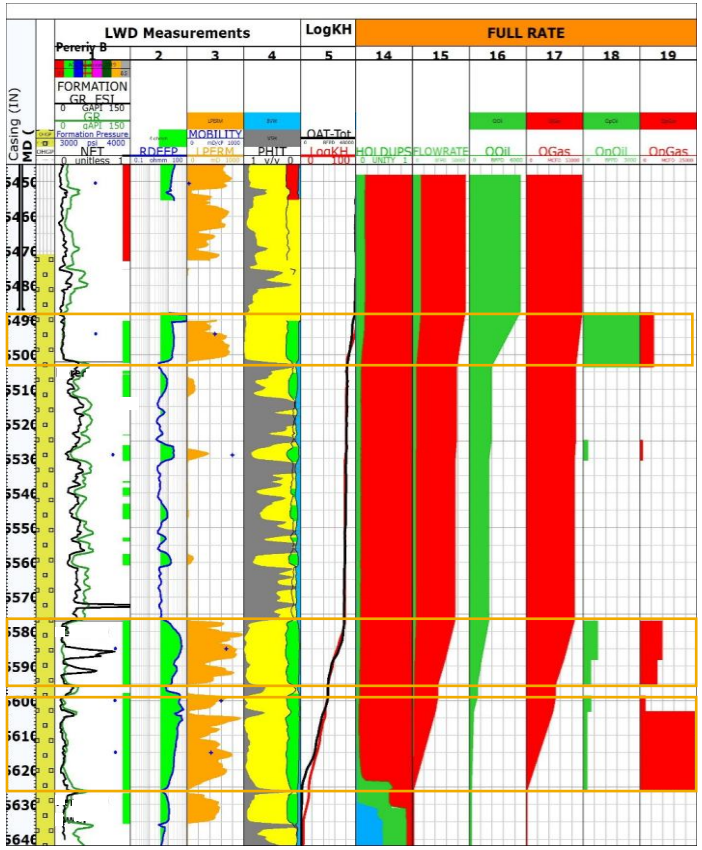
ACG field

Well Background

Completion Schematic

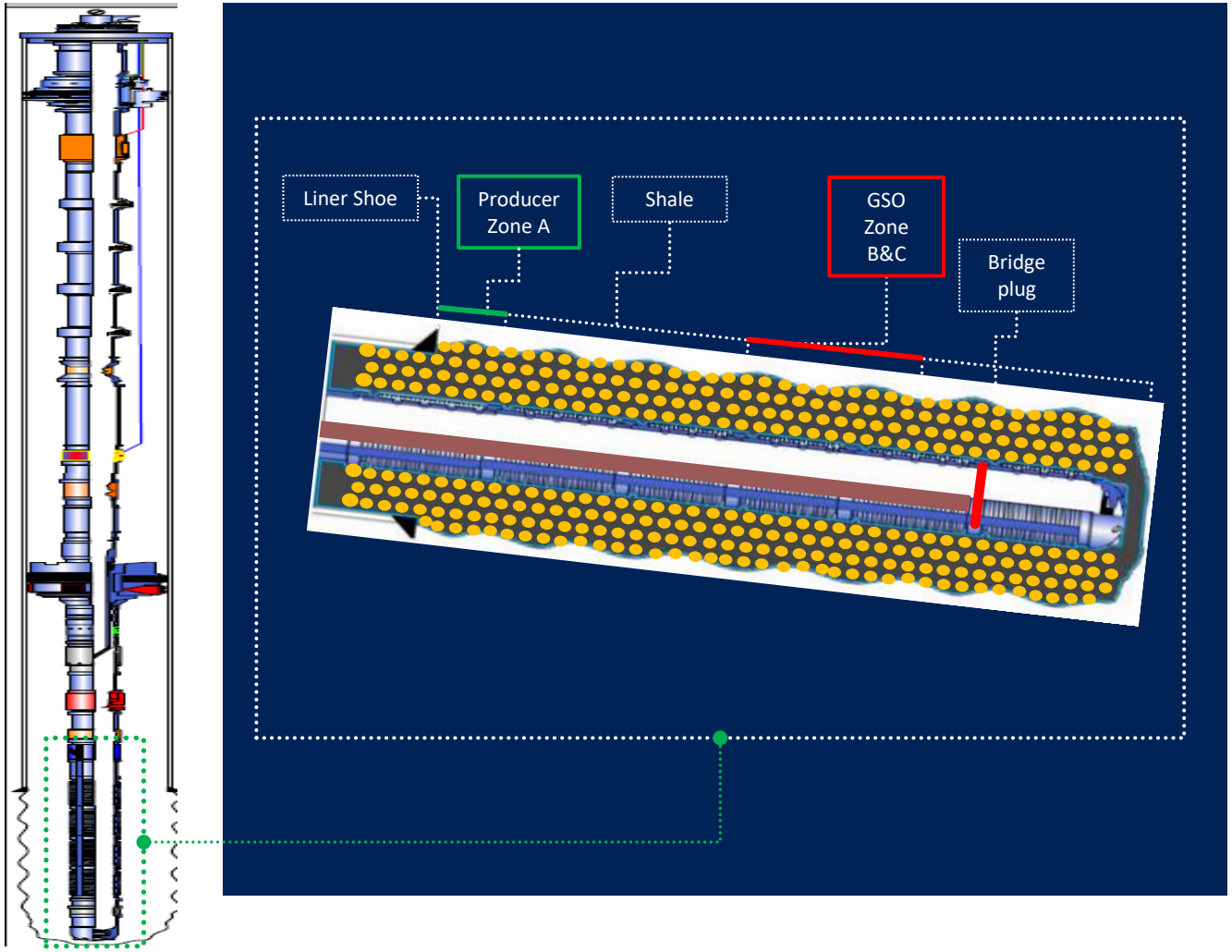


Well PLT results



- Producing since Jan 2018
- One of the Highest GOR well operated by in ACG field
- PLT indicate highest GOR from lower Zone C
- Well produced 1,400 bopd and 22.5 mmscfd

Well-Gas Shut-Off Treatment Objectives & Challenges



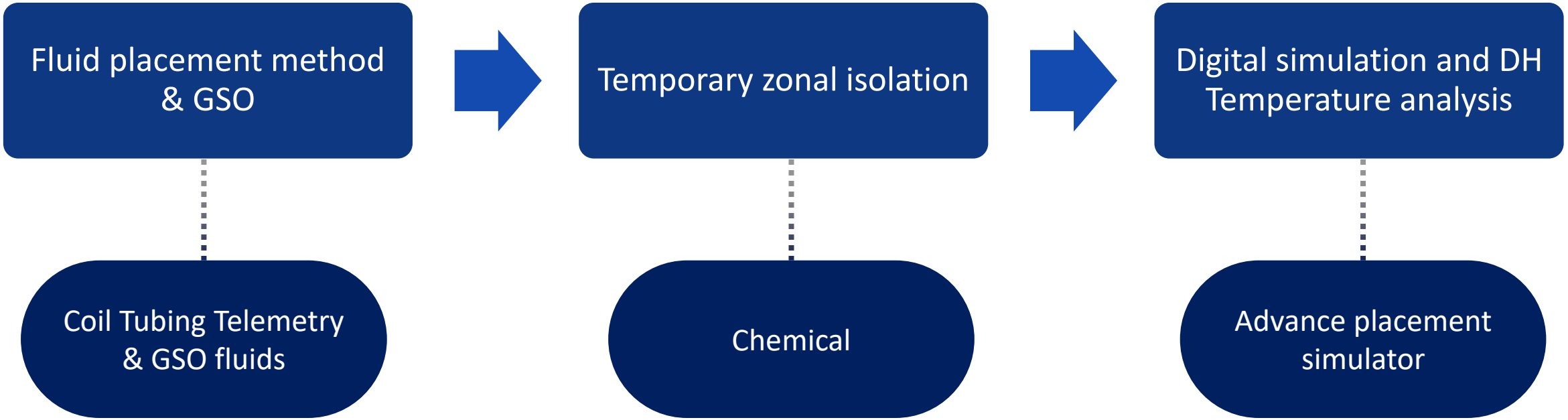
Objective :

- Shut off highest GOR zone (GSO Zone)

Challenges :

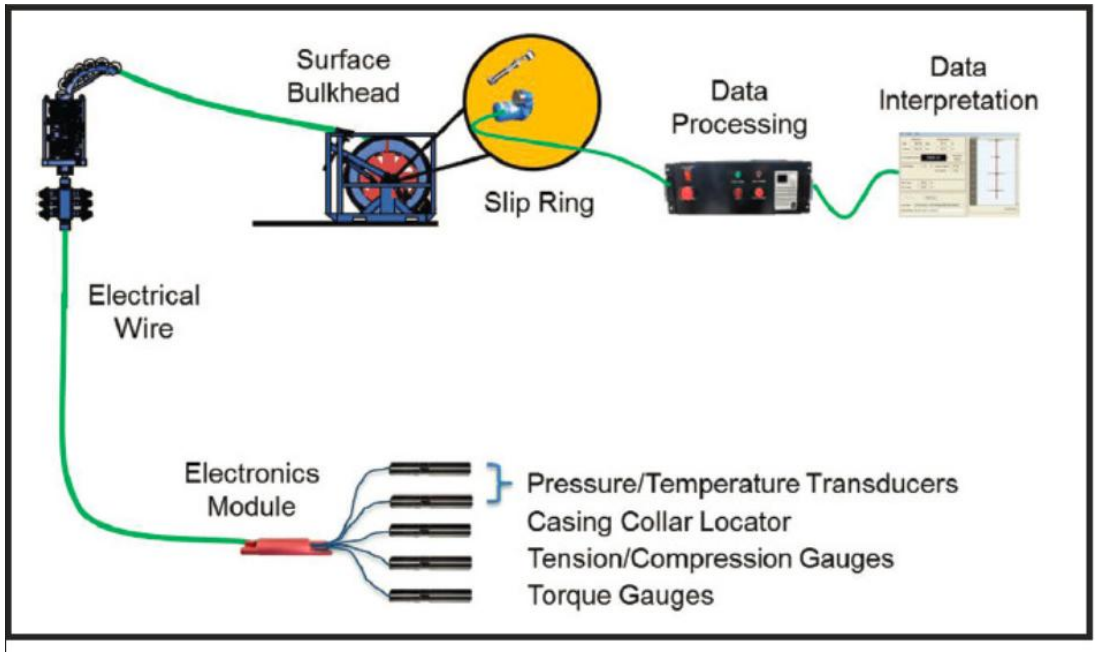
- High permeable pathway within annular pack implicate fluid placement for chemical shut off
- Lower zone shut off create higher chance fluid penetration to the upper zone, i.e. shutting off the producer zone
- Temporary Zonal isolation fluid may also block GSO Zone
- Cross flow from GSO zone to producer zone

Novel Fluid Placement Strategy



Fluid Placement Strategy-Coil Tubing Telemetry (CTT)

CTT wire system components



Technical Data

TCT sensor unit specifications

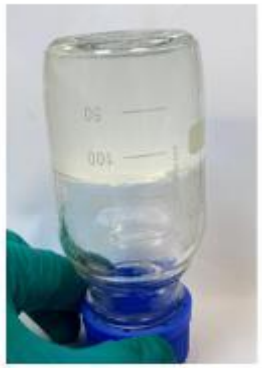
Dimensions & ratings	Size 2.125-in.	Size 2.875-in.	Sensor capabilities OD	Size 2.125-in.	Size 2.875-in.
OD	2.125-in.	2.875-in.	Axial load range	-3,500 to 30,000 lbf	-10,000 to 56,000 lbf
Make-up length	10 ft (3 m)	6.26 ft (1.9 m)	Axial load resolution	< 5%	< 5%
Max. external pressure	10,000 psi (689 bar)	9,000 psi (620.5 bar)	Axial measurement error	< 20 lbf	< 20 lbf
Max. temperature	300°F (149°C)	300°F (149°C)	Torque range	375 ft-lbf	1,500 ft-lbf
Max. differential pressure	5,000 psi (345 bar)	5,000 psi (345 bar)	Torque resolution	+/- 1 ft-lbf	< 20 ft-lbf
Max. flow rate	To 5,000 psi burst	8 BPM	Torque error margin	< 5%	< 2%

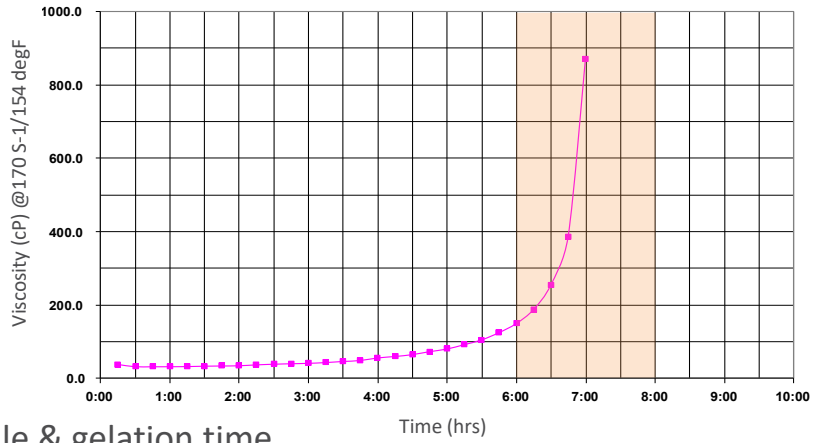
TCT sub-assembly specifications

- It was the first trial run of 2-1/8” TCT in the region

GSO & Temporary Zonal Isolation Fluid

GSO Fluids

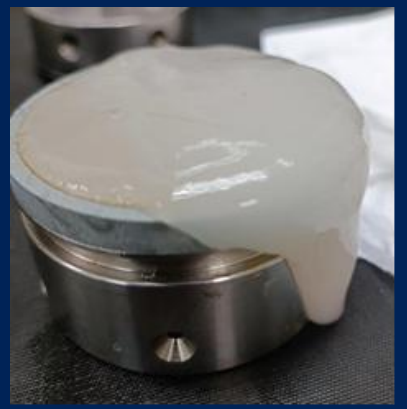




Fluid viscosity profile & gelation time

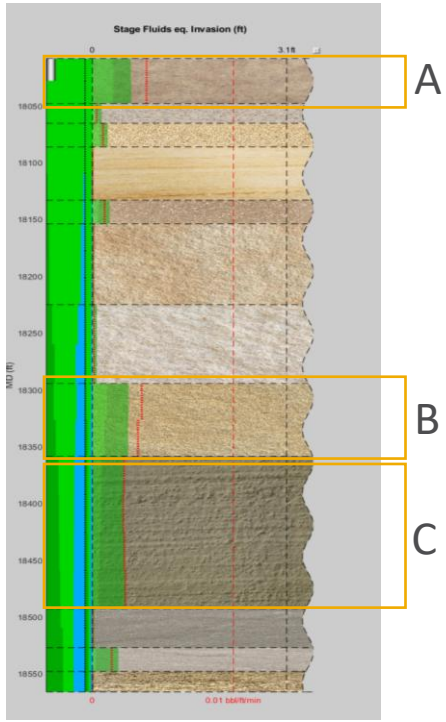
- Crosslinked organic polymer gel
- Activation based on time and temperature
- Low molecular weight and viscosity allowed treatment through Coil tubing

Temporary Zonal Isolation Fluid (TZIF)
X-Link HEC

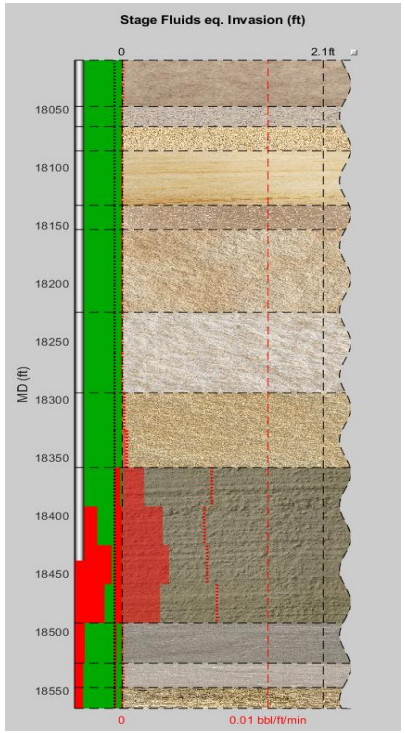


- Delayed system allow pumping through CT
- Activation based on time and temperature
- Break by acid/oxidative breaker
- Slow breaking formulations for producer zones
- Fast breaking formulations w. oxidative breaker for shut off zones

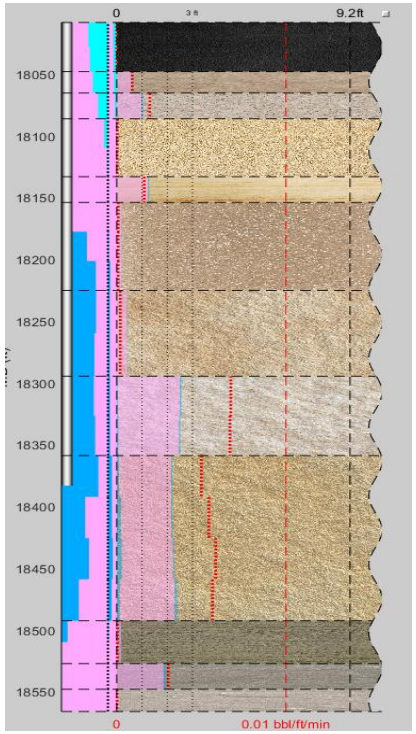
Fluid Placement Simulation & Design Optimization



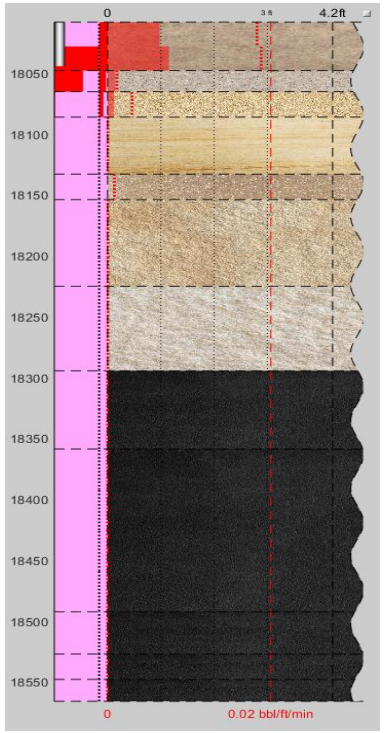
Temporary zonal isolation placement
Optimize volumes and depth of penetration between slow breaking TZIF (zone A) and fast breaking TZIF (zone B&C)



Acid placement
Optimize acid volumes and depth of penetration to clean residual TZIF in zone C. Post modeling observe potential shut off for zone B, due to narrow distance



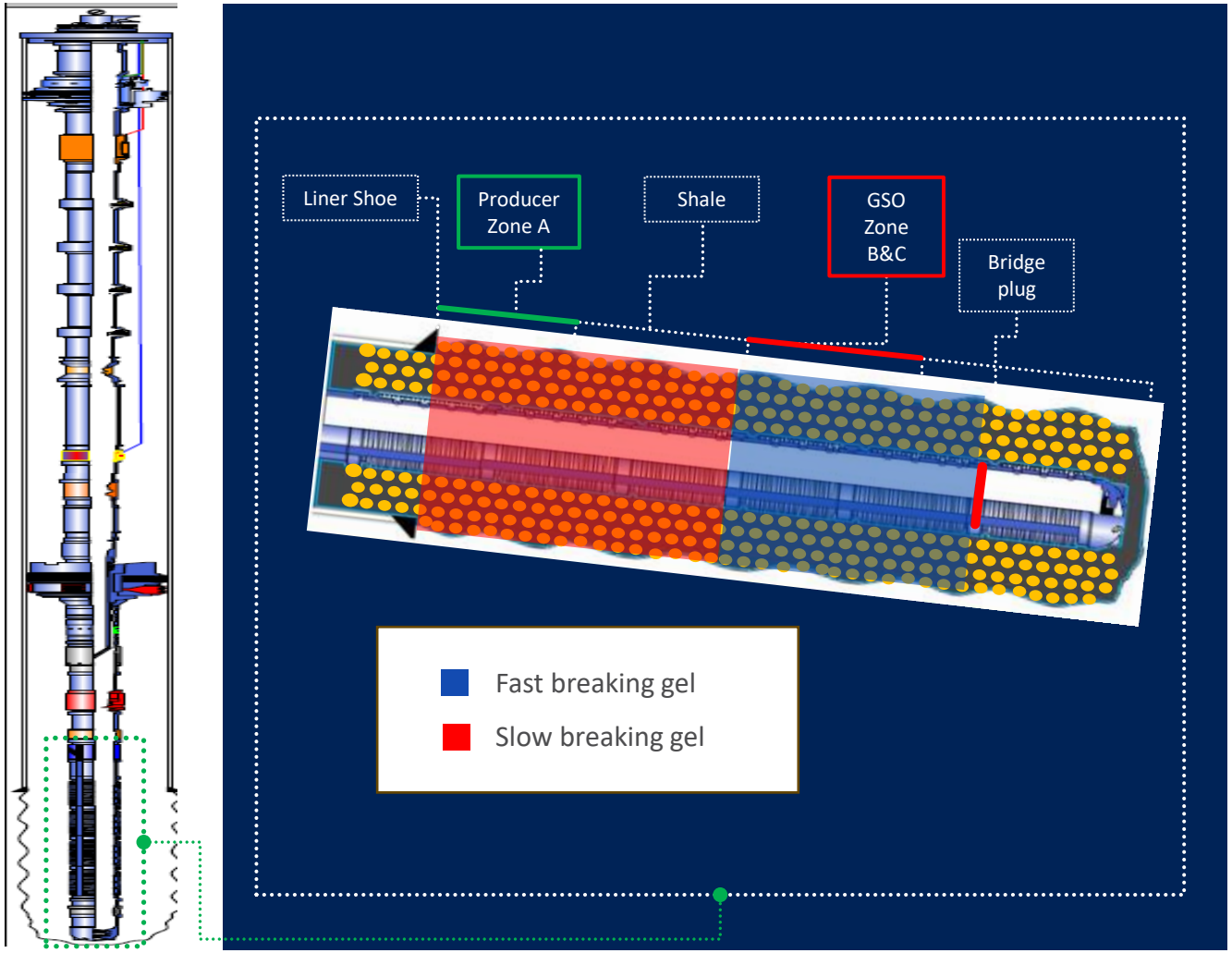
GSO fluid placement for Zone B & C
Optimize GSO fluid volumes and depth of penetration



Zone A Acid Placement
Optimize acid volumes and depth of penetration to clean residual TZIF in zone A.

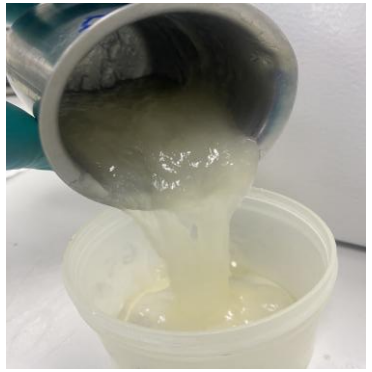
Slow breaking TZIF
Fast breaking TZIF
7.5% HCl
GSO Fluid
Isolated zone

Gas Shut-Off Treatment Design and execution



Step 1 :

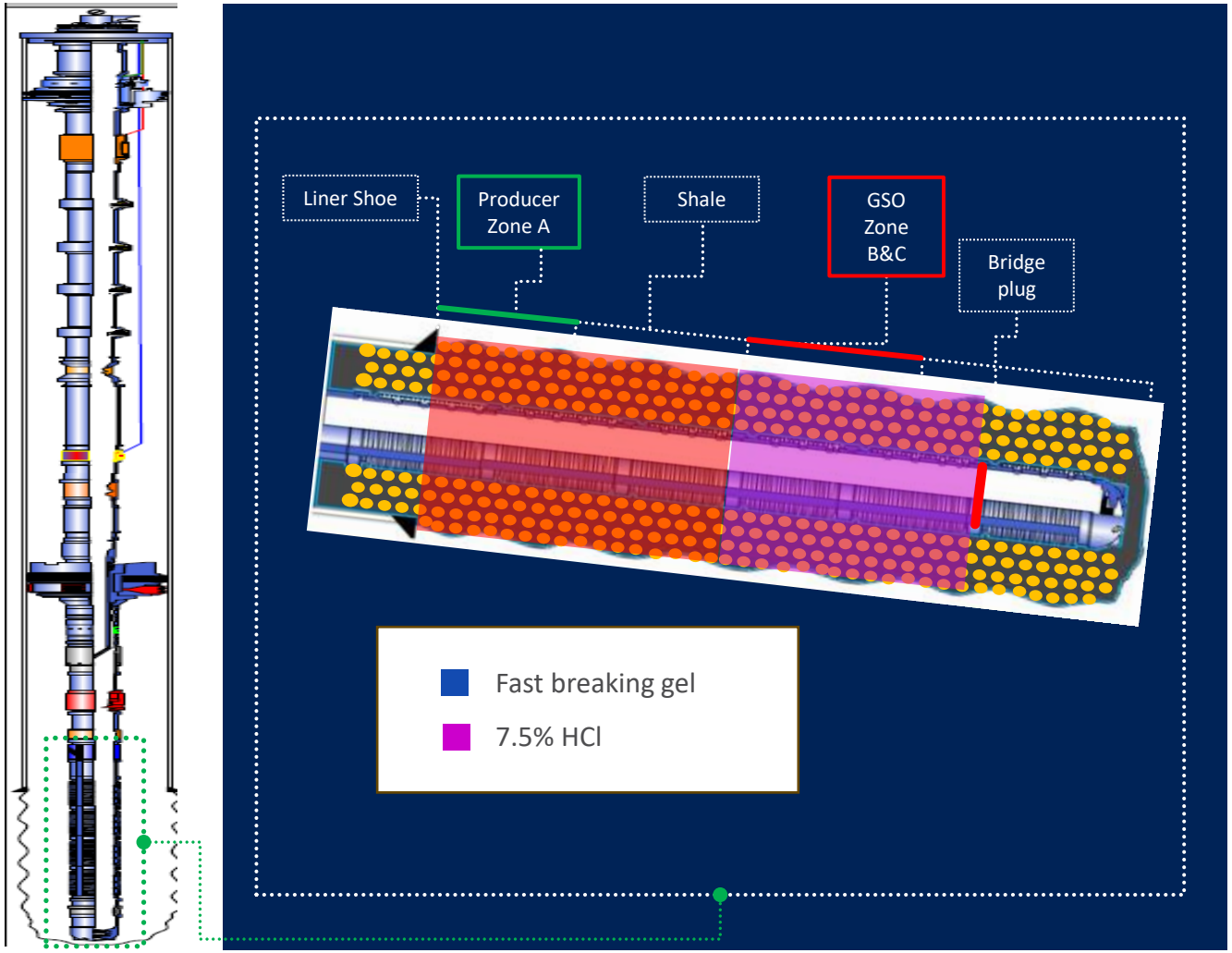
- Spotting fast & slow breaking isolation fluids



Slow breaking gel after 24 hrs

Fast breaking gel after 2 hrs

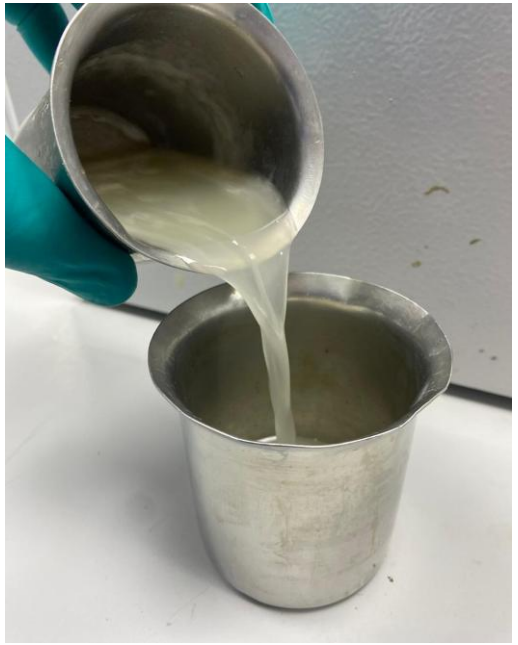
Gas Shut-Off Treatment Design and execution



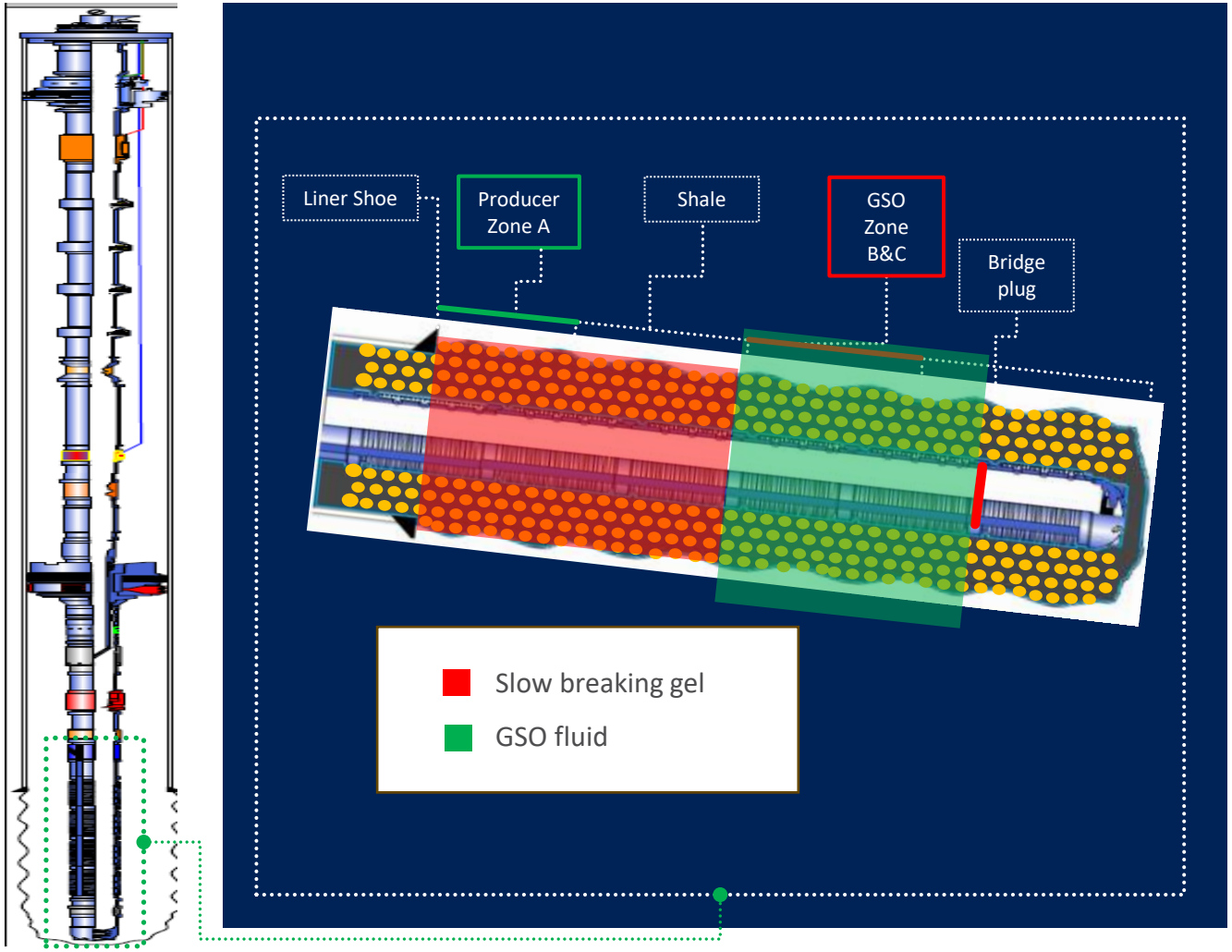
Step 2 :

- Spotting acid at GSO zones

- Acid placed at GSO zone to assure gel clean up



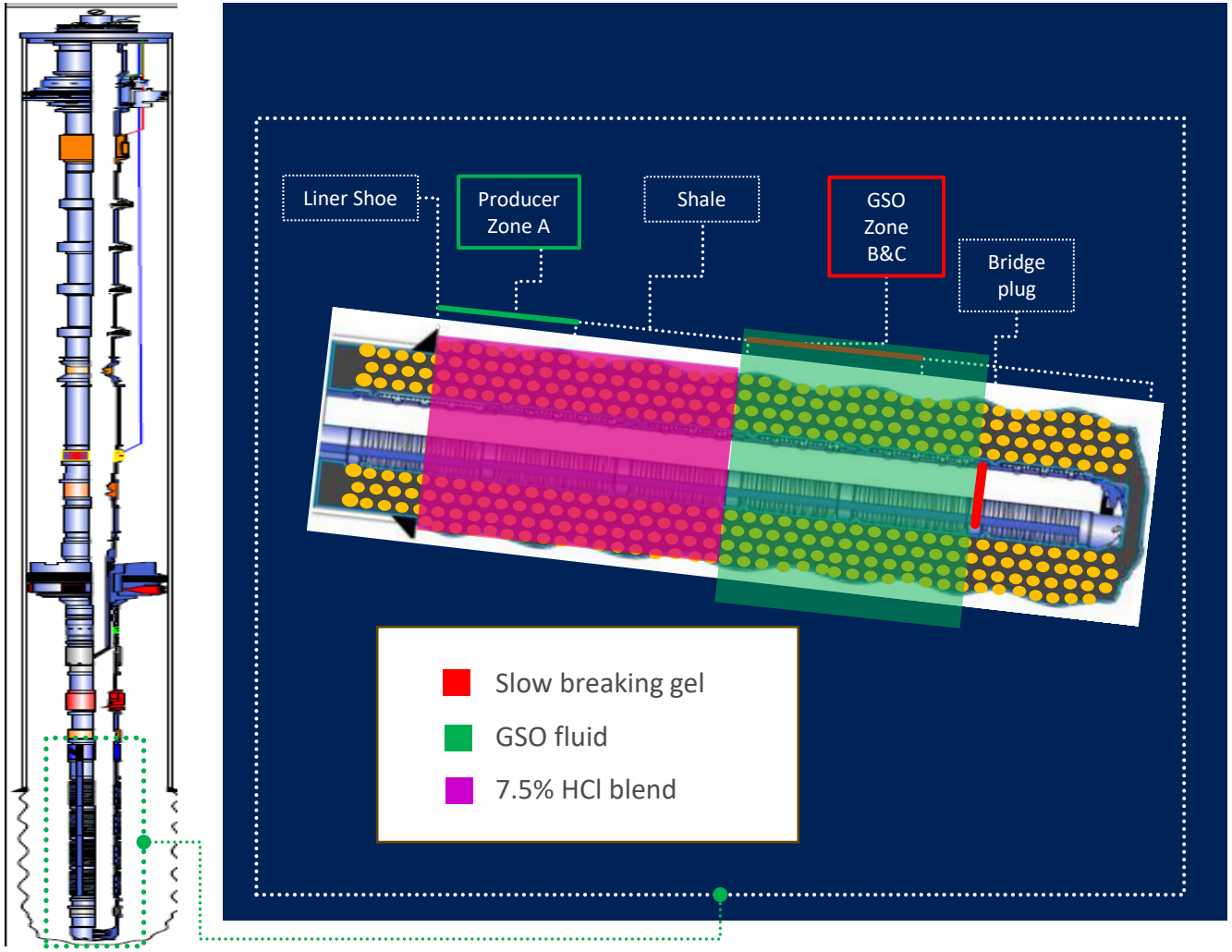
Gas Shut-Off Treatment Design



Step 3 :

- Injecting GSO fluid to GSO Zone

Gas Shut-Off Treatment Design and execution



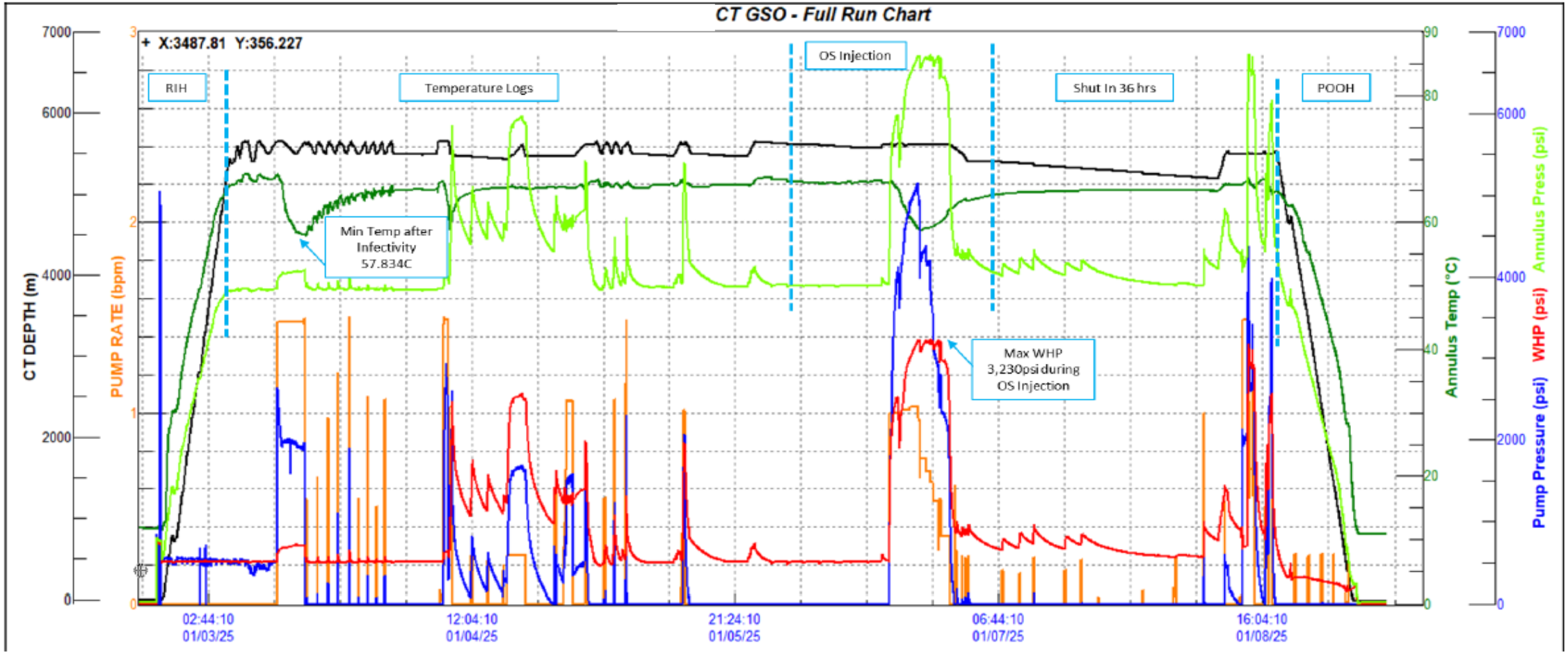
Step 4 :

- Acid treatment to Zona A

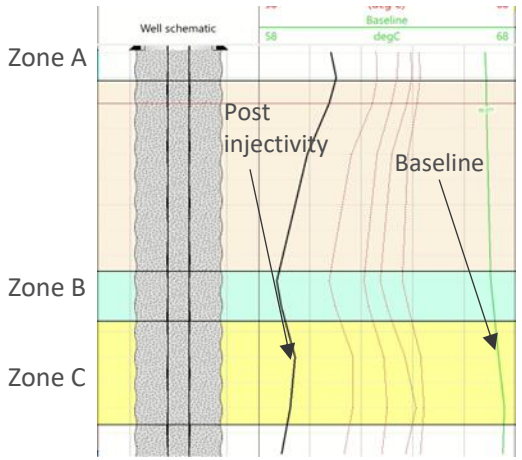
- 7.5% HCl injected to dissolve slow breaking gel

Job Execution-Key Sequences

Run#1, Full Job Chart – Injectivity, Temperature Log, OS Placement & HCl Pumping with 2 1/8" OD Nozzle

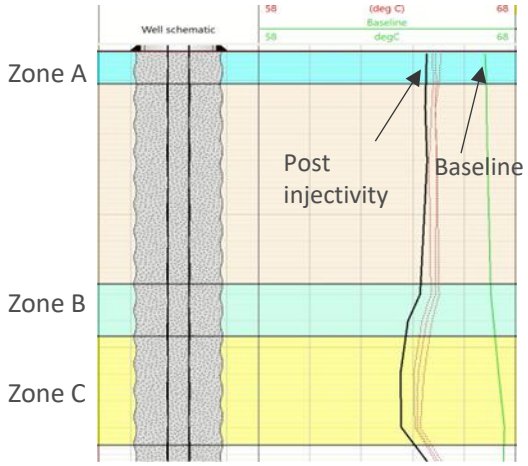


Temperature Evolution Analysis



Pre-Job 1

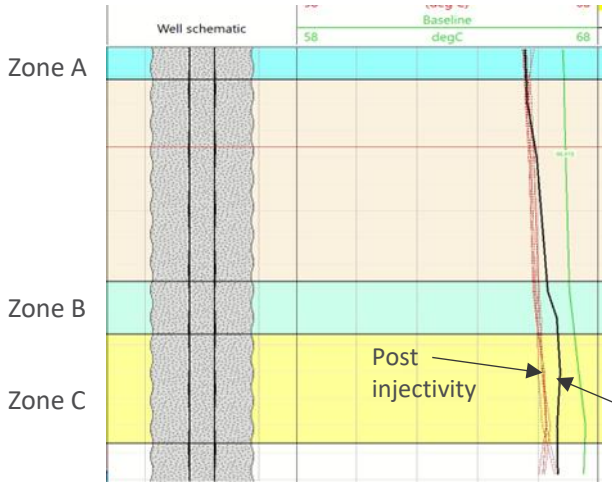
- Injectivity at Zone C
- Injection shows significant cool down on all zones



Pre-Job 2

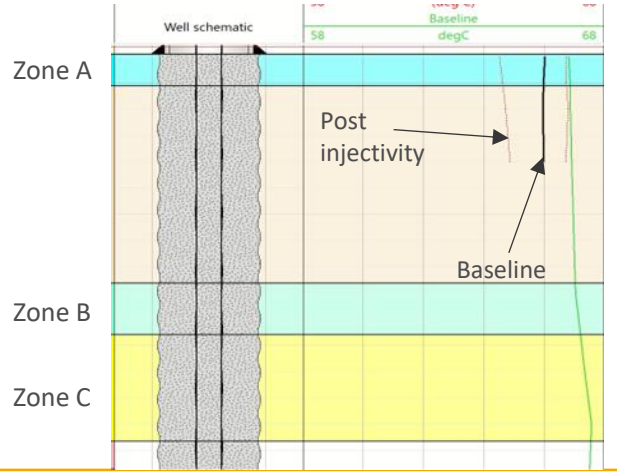
- Injectivity at Zone A
- Injection shows significant cool down on all zones

Temperature Evolution Analysis



Post TZIF placement & lower zone HCl

- Baseline provides minor changes from initial injection in Zone A
- Post injection shows cooling down in B&C and constant minor changes in A, indicates minor leak off to A and good injection to C



Post GSO fluid placement & Zone A HCl

- Post HCl,Temp. Increase due to exothermic reactions
- Cool down post acid indicate clean up in, hence did not go to pre-job cooldown
- Indicates improvement required to clean up zone A (pump additional HCl)

Summary & results