Octopoda™: A Quantum Leap in Intervention

Reduction of Annulus Pressure via Innovative Annulus Intervention

Petronas Offshore Malaysia: IADC/SPE-209882-MS & SPE-214576-MS

Society of Petroleum Engineers IADC

IADC/SPE-209882-MS

Making Wells Safer; Rectification of High Annulus Pressure via Diagnostic and New Technologies Through Annulus Intervention Method

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Agenda

Annulus Intervention

- Sabah: XK-2 & XK-3 SCP Challenges
- Sabah: XK-1 Annulus Intervention
  - SCP Challenge
  - Octopoda™ Selection Criteria
  - Planning Phase
  - Execution
  - Outcome

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Octopoda Annulus Intervention
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Sabah Field Historical Challenge, Well XK-2 & XK-3 (2009)

Customer Challenge

Sustained Casing Pressure

Leaking cement

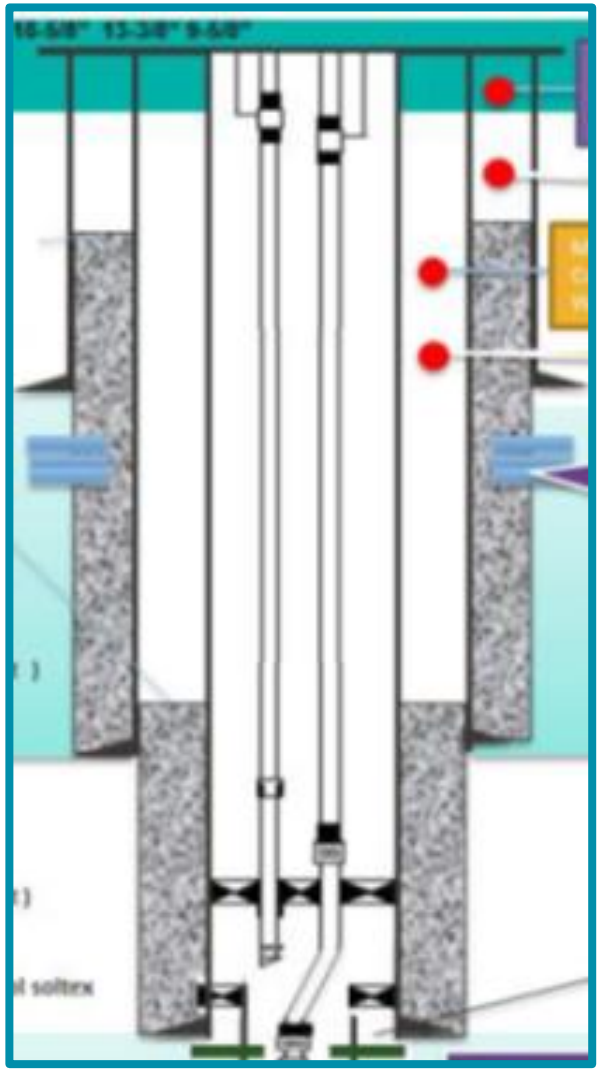
B & C Annulus Sustained Casing Pressure (500psi)

Shallow Gas Source Channelling Through Cement

Exceed Regulators Limits (300psi) & Wells Shut-in

Lube & Bleed With Heavy Brine Unsuccessful

Rig Workover & Recompletion Performed (2010)



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Petronas Offshore Malaysia, Well XK-1 (2020)

Customer Challenge

Sustained Casing Pressure

Leaking cement

B Annulus (9 5/8”x 13 3/8”) Sustained Casing Pressure (500psi)

Shallow Gas Source Channelling Through Cement

Exceed Regulators Limits (300psi) & Well Shut-in

Petronas sought a cost-effective alternative to rig workover and a more efficient and reliable solution to lubricate & bleed

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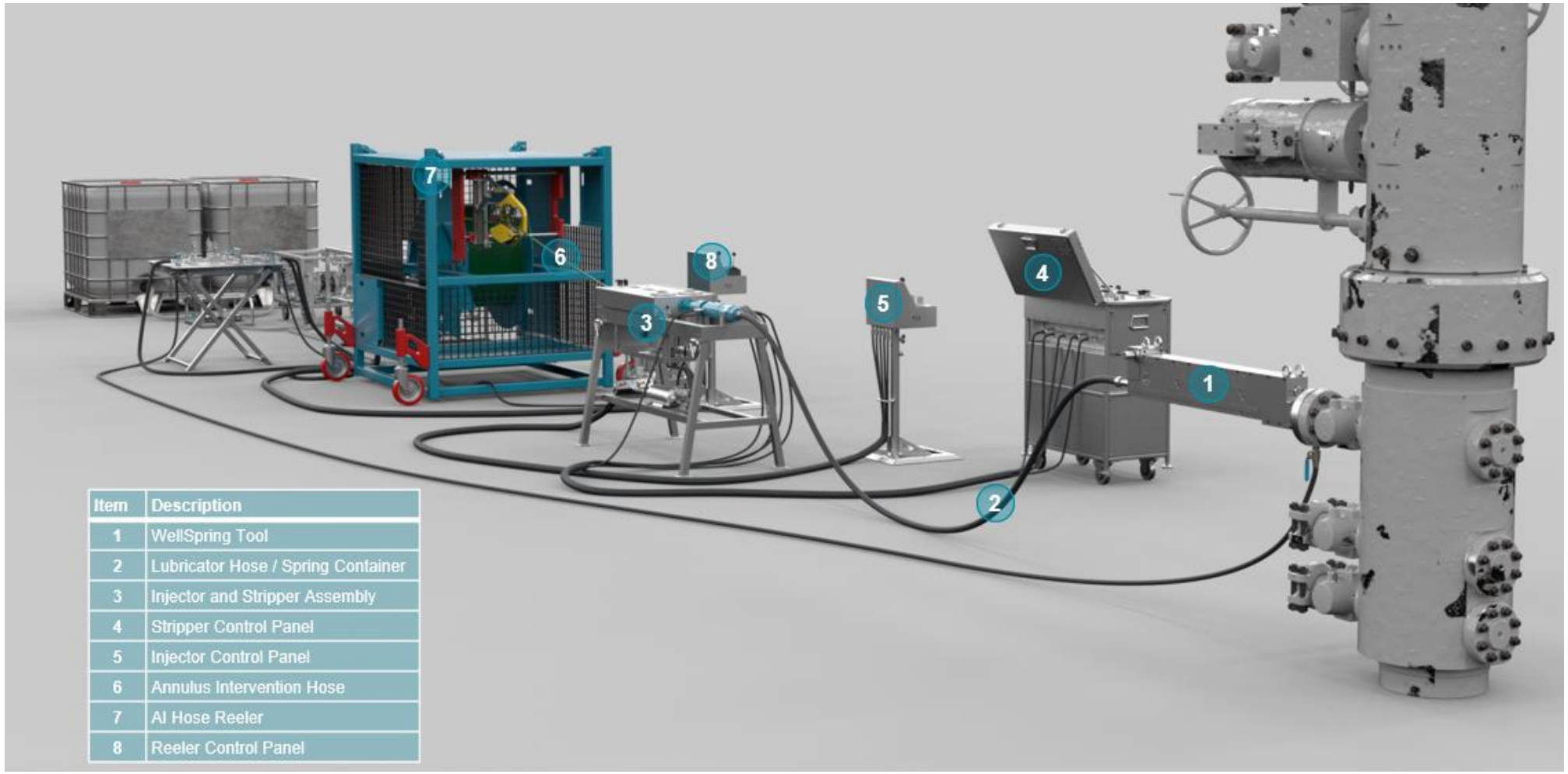
Petronas Technology Selection Criteria

Expro Solution

Rig-less Compact, Small Footprint & Quick Rig-Up



Item	Description
1	WellSpring Tool
2	Lubricator Hose / Spring Container
3	Injector and Stripper Assembly
4	Stripper Control Panel
5	Injector Control Panel
6	Annulus Intervention Hose
7	Al Hose Reeler
8	Reeler Control Panel

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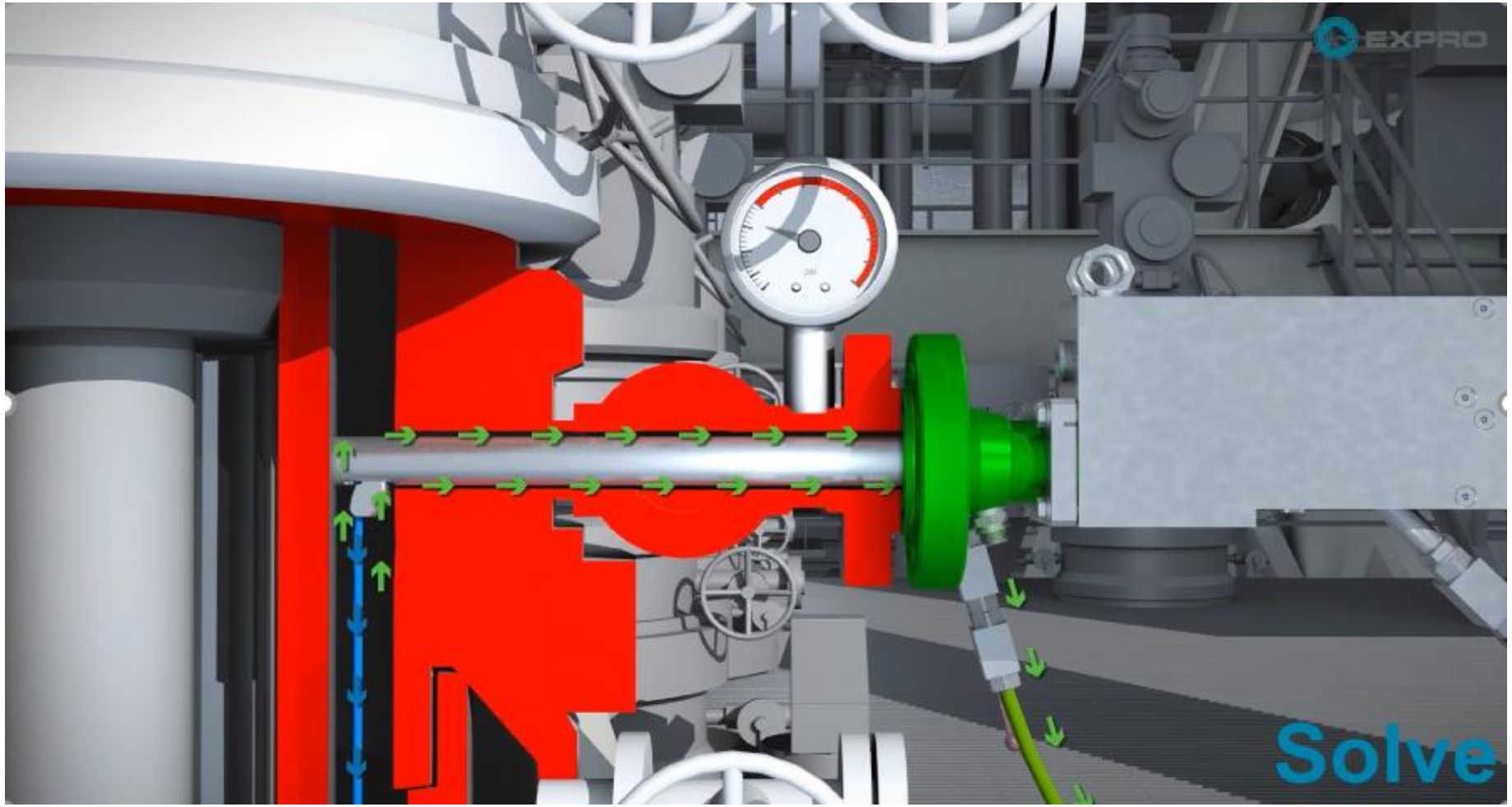
Petronas Technology Selection Criteria

Expro Solution

Hose Deployed Into Pressurised Annulus



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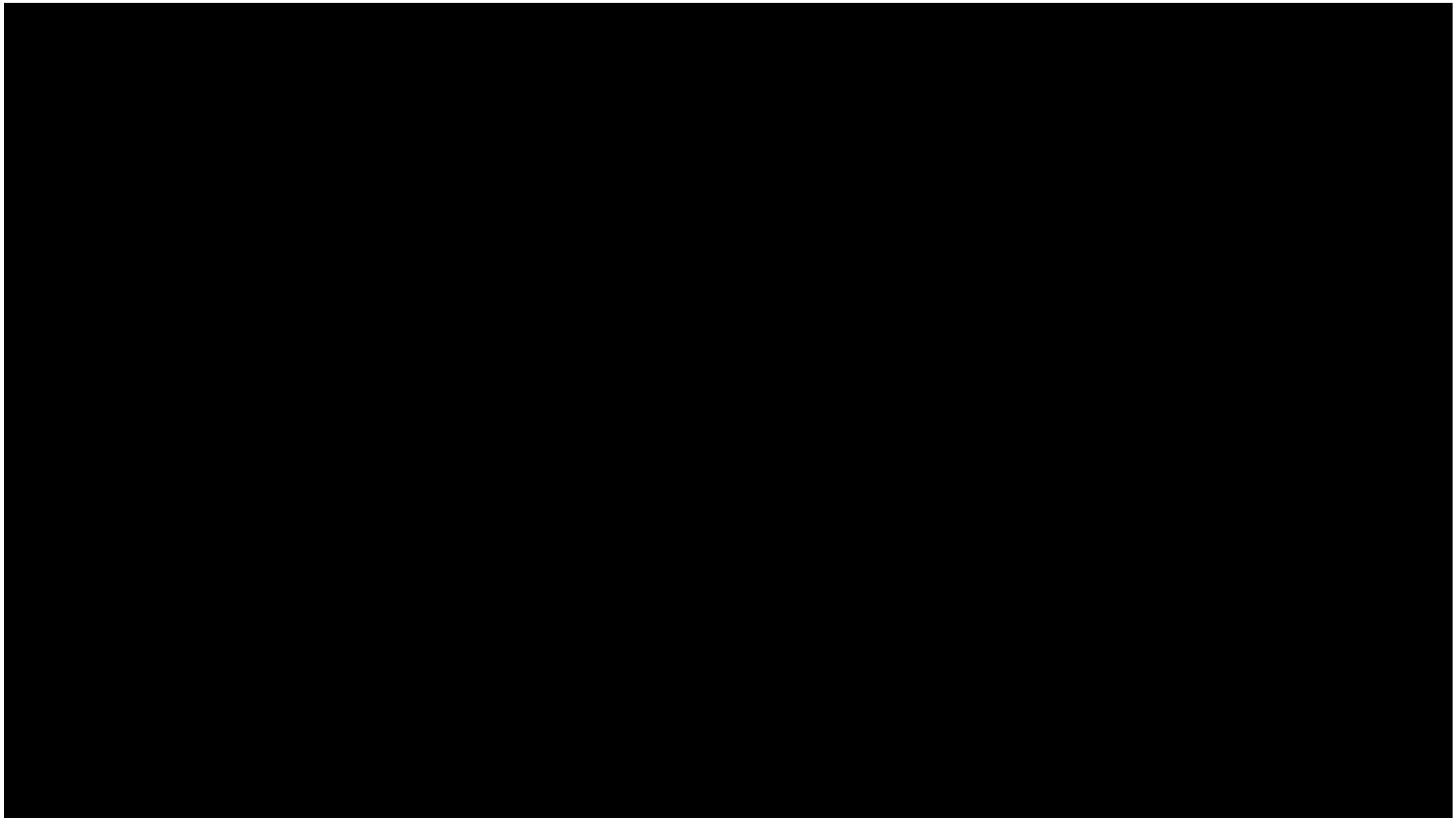
Animation



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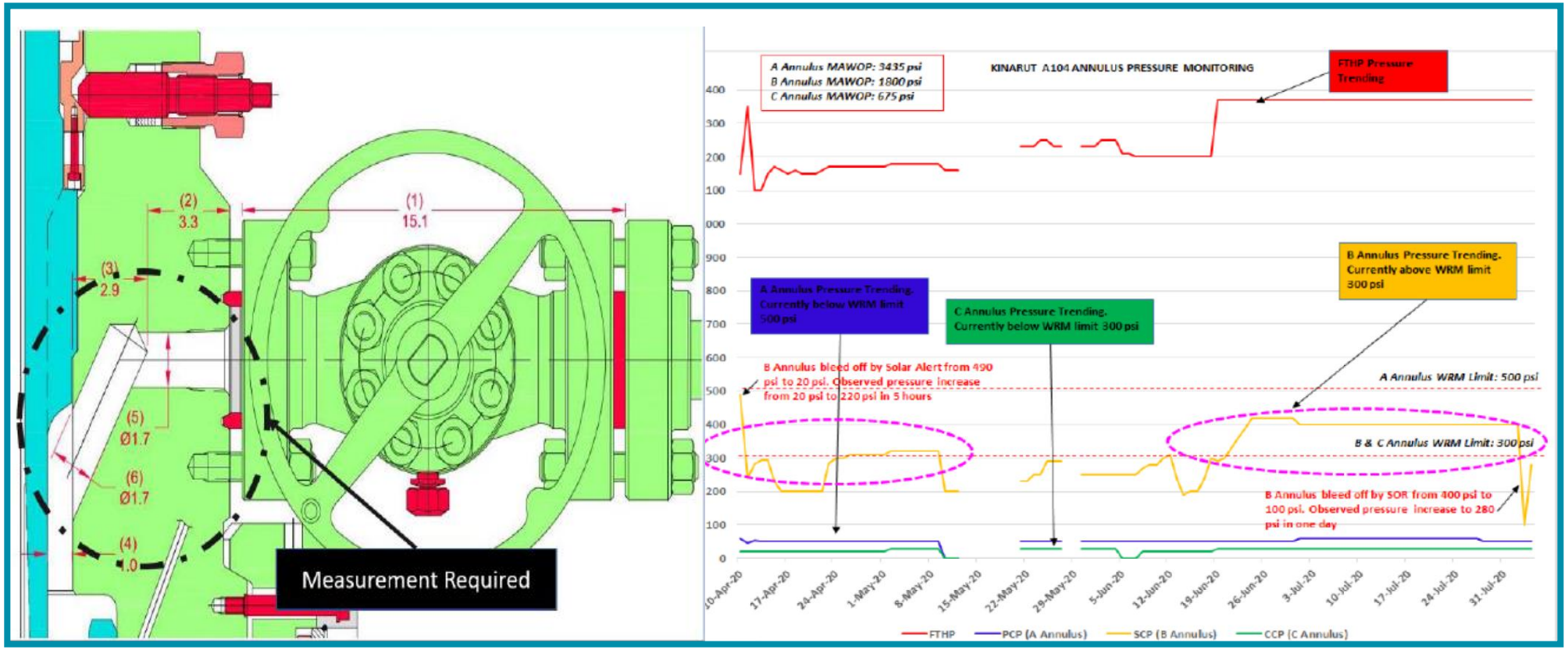
Planning Phase: Initial Engineering

Expro Solution

Evaluate Access & Integrity Status



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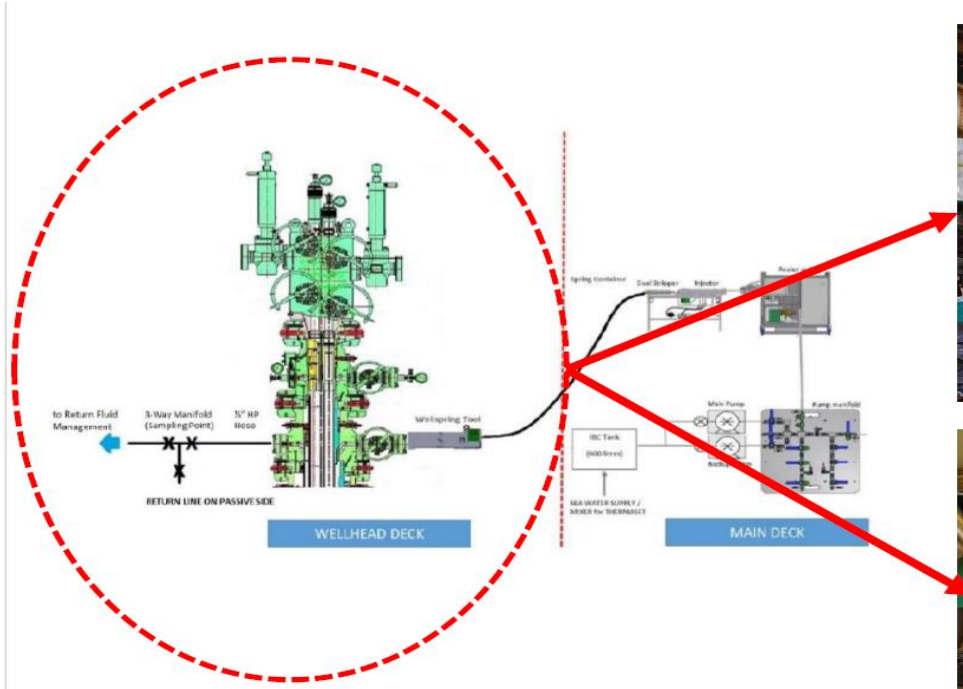
Planning Phase: Site Visit

Expro Solution

Wellhead & Facilities Survey



AI WELLSPRING TOOL – Rig up on the Well Head Deck to Active Side. Return Line to Sump Line on the Passive Side of the Wellhead

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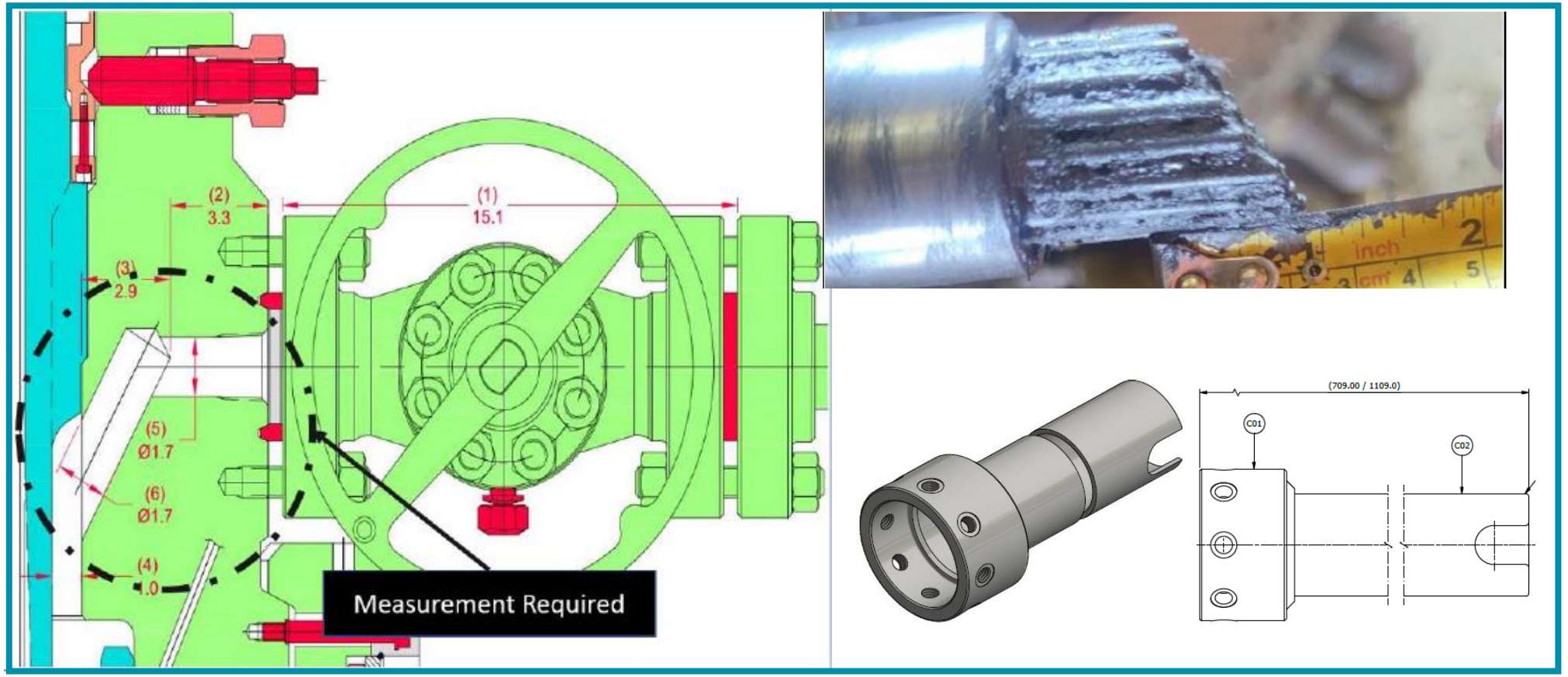
Planning Phase: Tailored Design

Expro Solution

Survey Interpretation & Modified Outer Pipe



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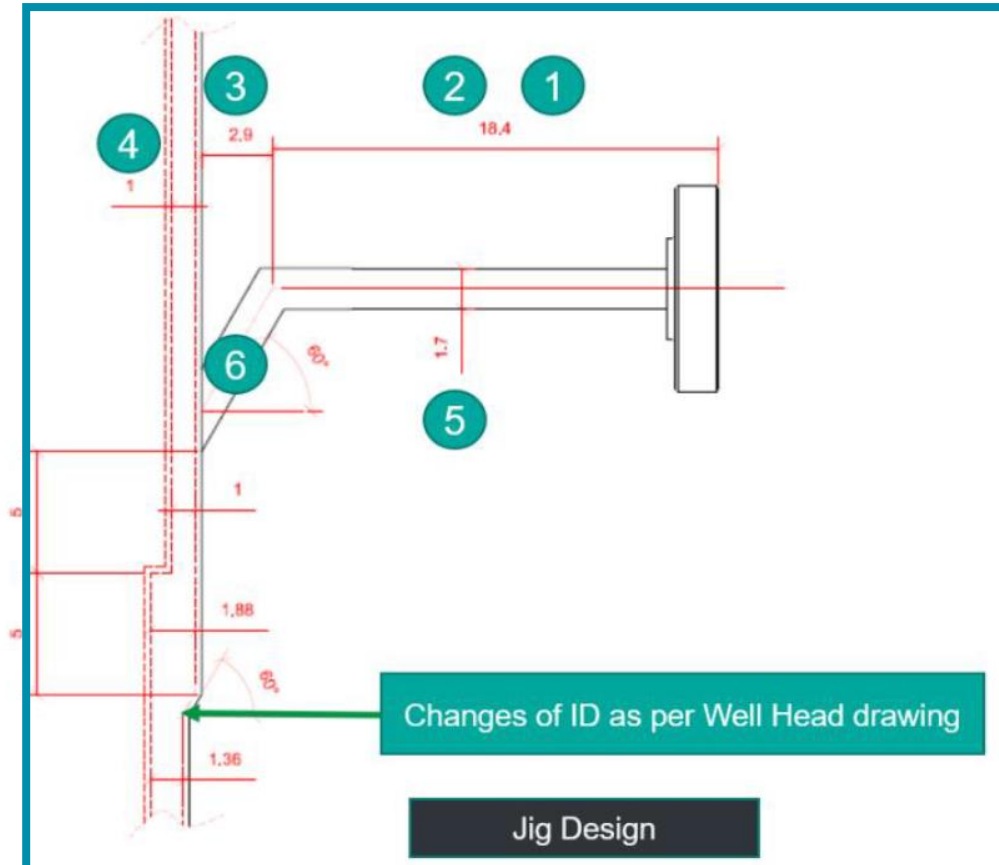
Planning Phase: System Integration Test

Expro Solution

Replicate Tool Access With Test-Jig



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Planning Phase: Technical Evaluation

Expro Solution

Diagnosis & Detailed Job Design

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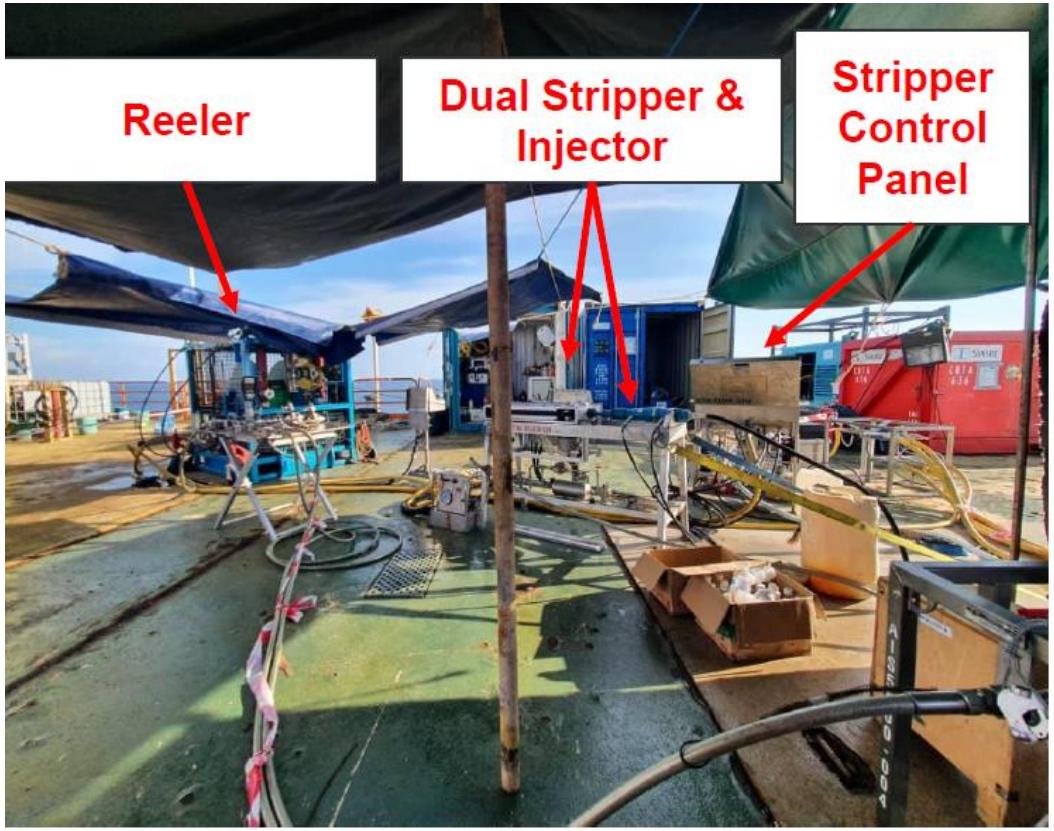
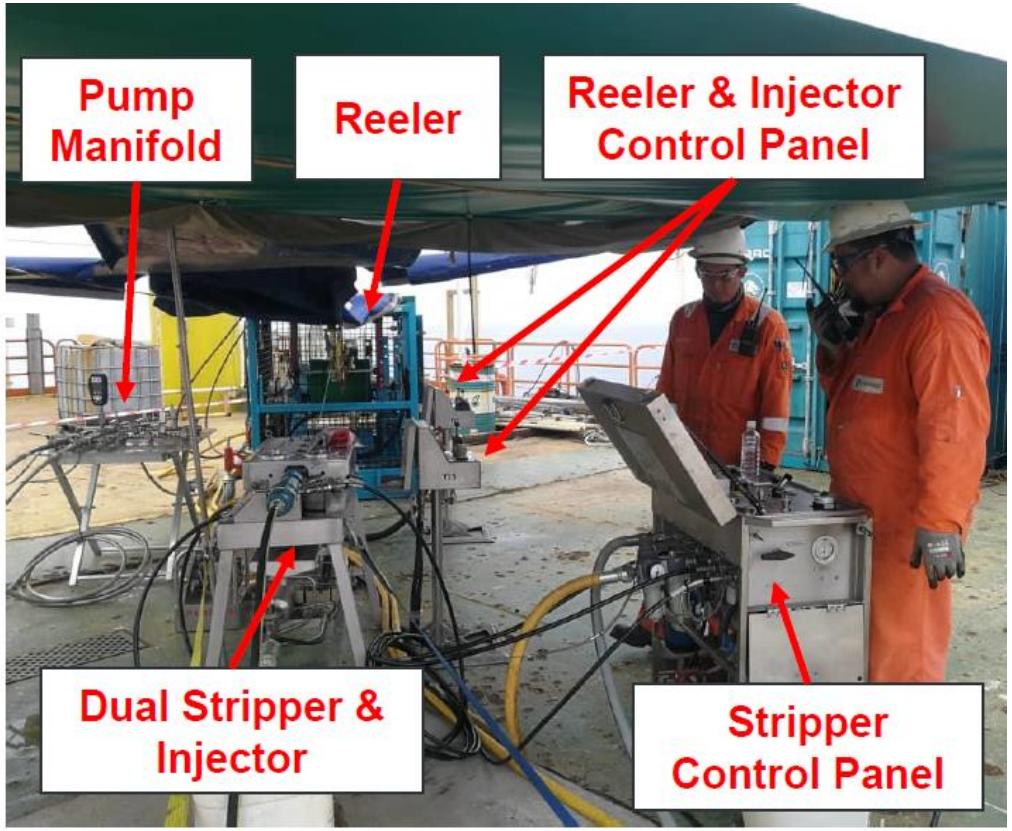
Planning/Mobilization Phase

Expro Solution

Deployment

Execution Strategy & Equipment Mobilisation





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XK-1 Execution : Annulus Status & Fluid Selection

Deployment

Source:

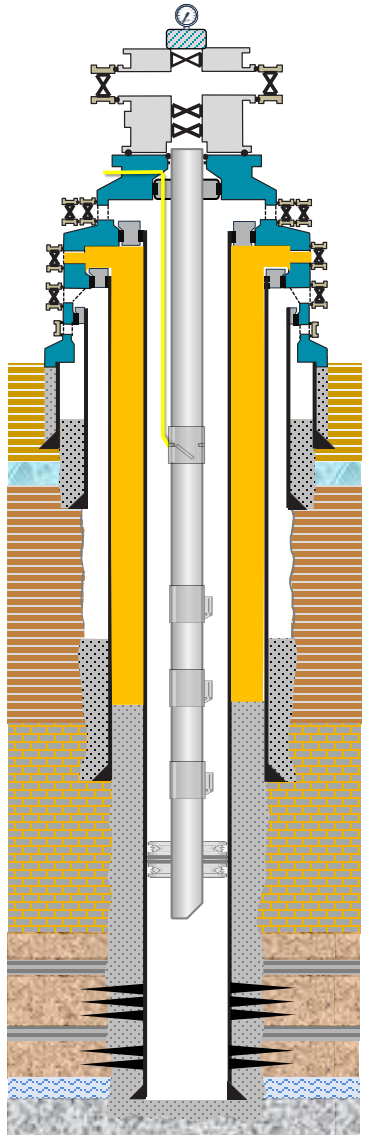
- Lower Kamunsu Sand
- 6879ft TVD, 1480psi

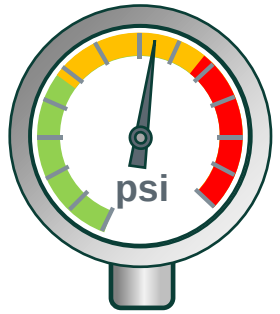
Annulus Content:

- 9.2ppg KCL WBM
- TOC = 3700ft TVD

Fluid Selection:

- 14.8ppg $CaCl_2/CaBr_2$
- Hydrostatic Overbalance
- Inhibition Package





B Annulus Pressure

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XK-1 Execution: Fluid Swap Sequence

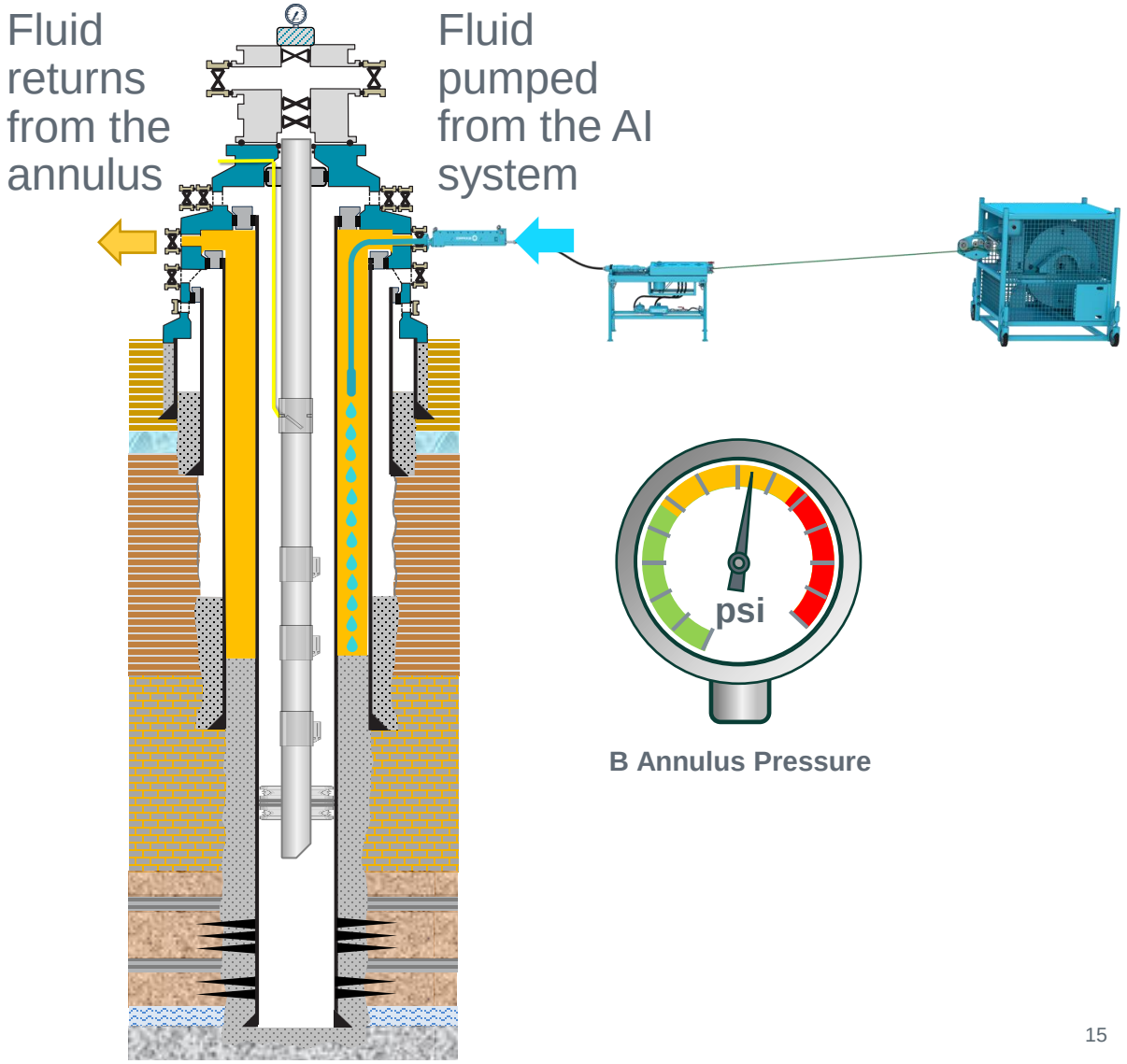
Deployment

Hose Deployment:

- Access Successful
- 75ft Achieved
- Circulation Path Created

Fluid Circulation:

- Brine Supplied in Totes
- Circulation Rate Dictated By:
  - Hose ID
  - Hose Length
  - Brine PV



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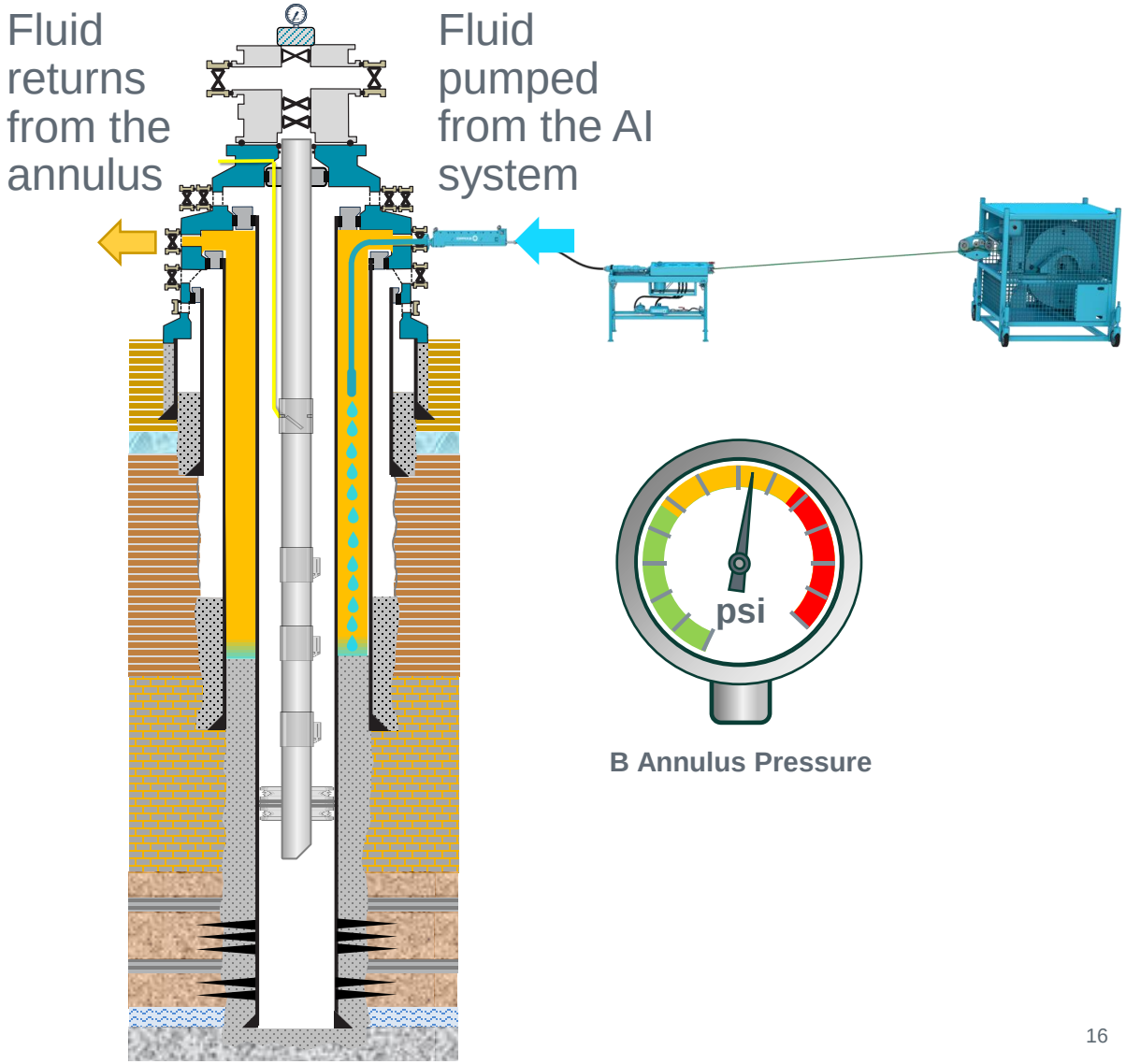
XK-1 Execution: Fluid Swap Sequence

Deployment

Returns Handling:

- Via Passive Side
- In-line Choke
- Holding Tank
- Sampling Point



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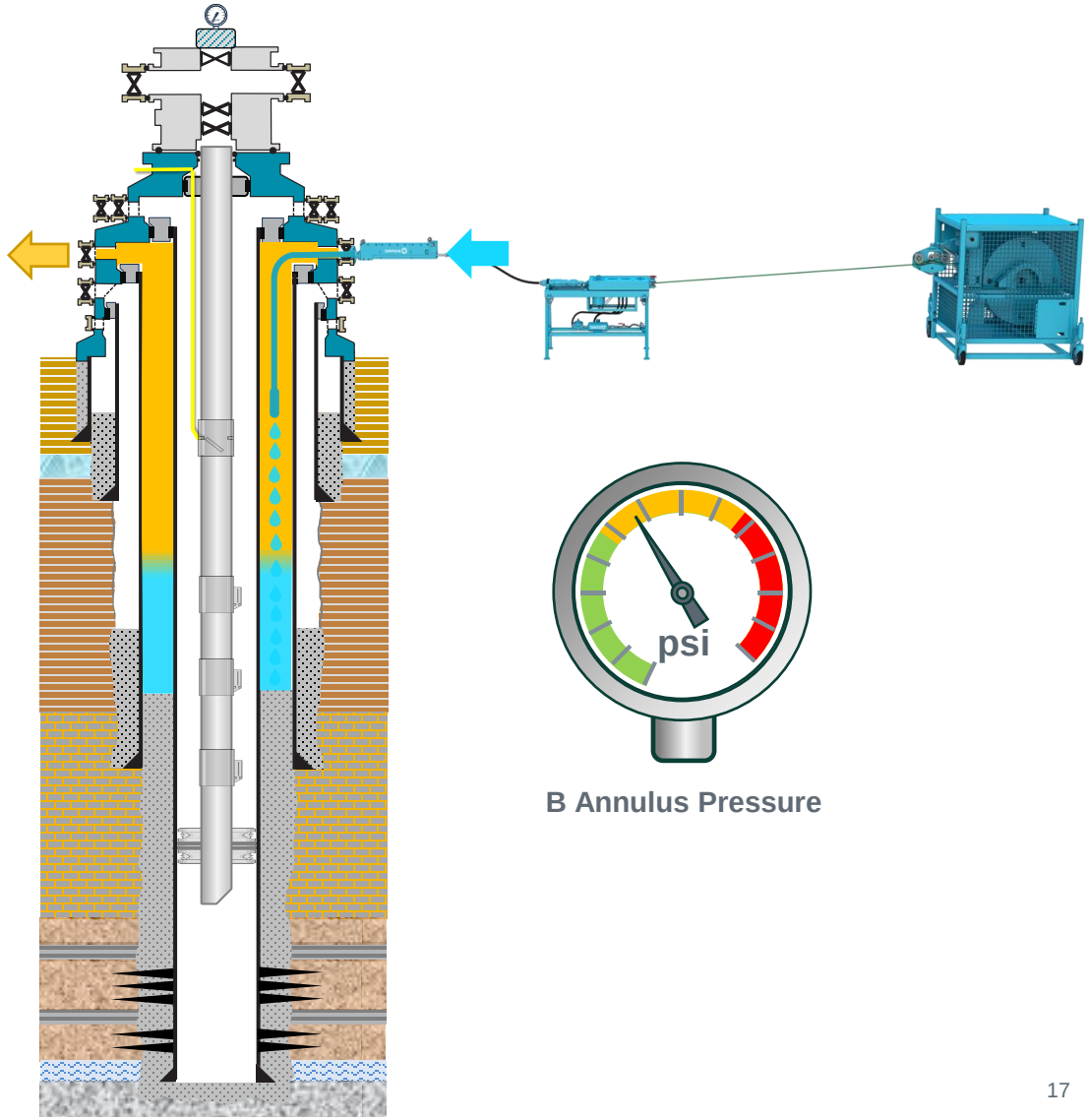
XK-1 Execution: Fluid Swap Sequence

Deployment

Returns Monitoring:

- Density Checks
- Water/Oil Content
- Adjust Parameters



B Annulus Pressure

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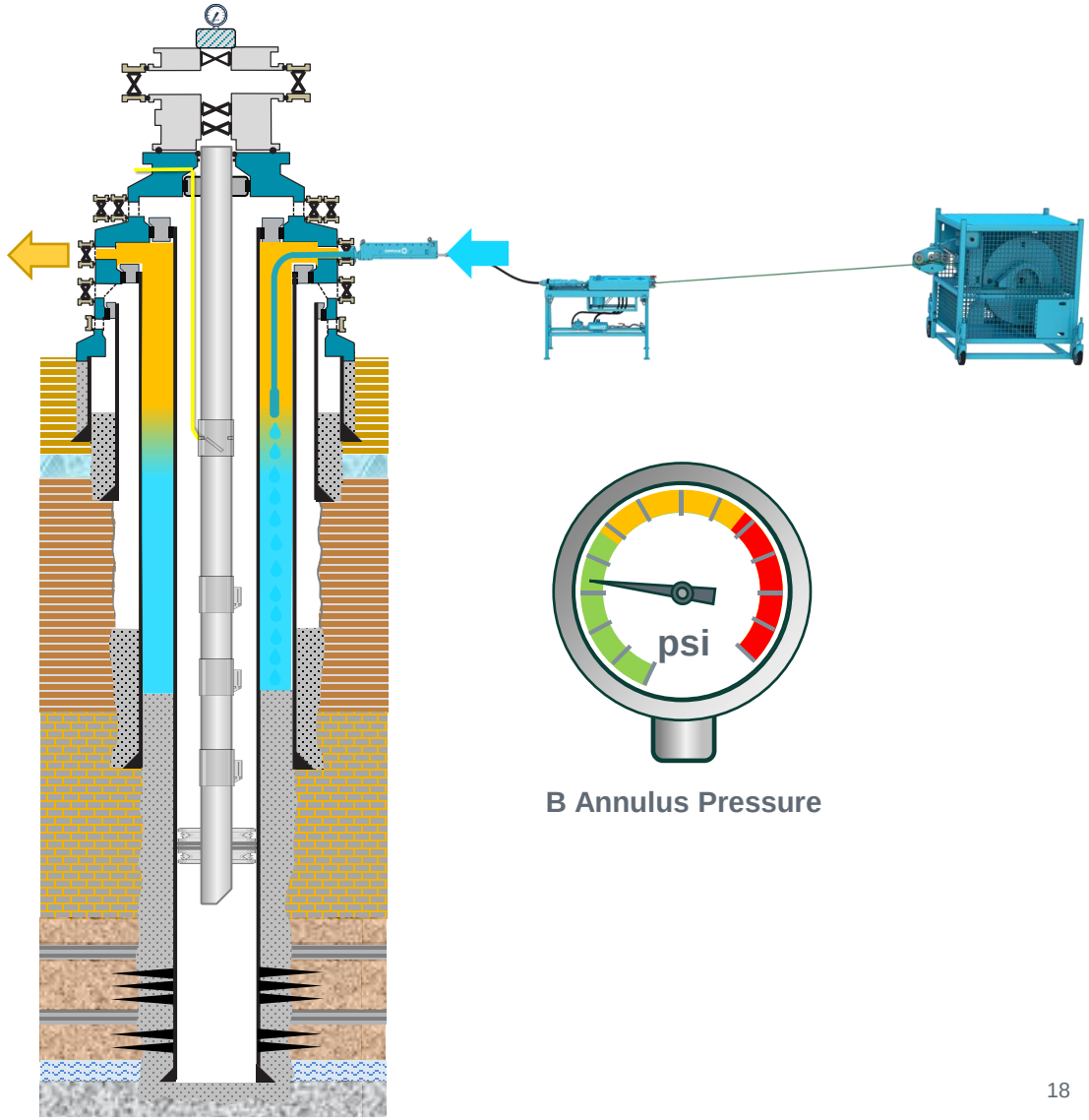
XK-1 Execution: Fluid Swap Sequence

Deployment

Pressure Build-Up:

- Periodic Shut-Ins
- Allow Fluids Freefall/mix
- Monitor Job Progress



B Annulus Pressure

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XK-1 Execution: Fluid Swap Sequence

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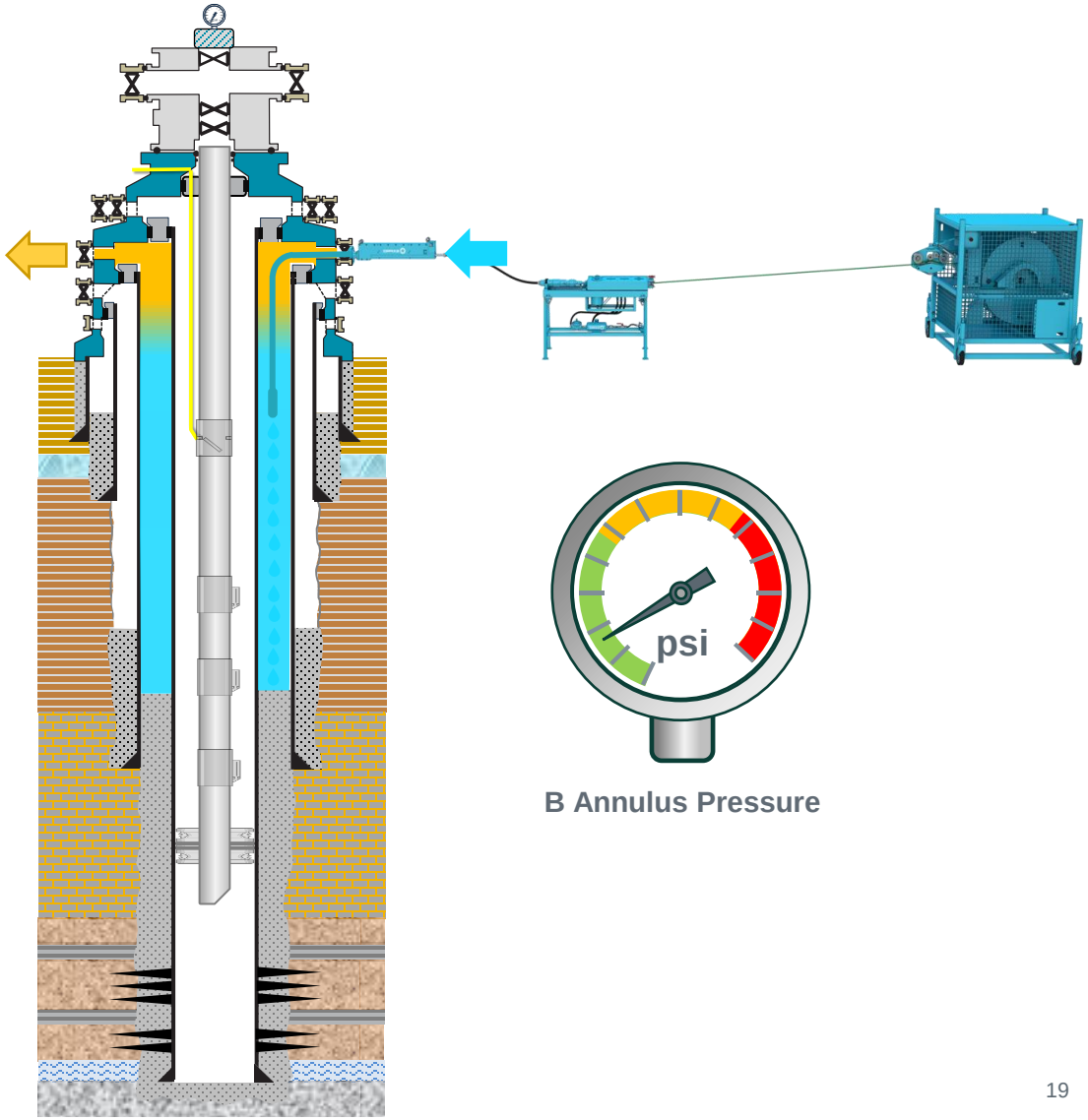

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XK-1 Execution: Fluid Swap Sequence

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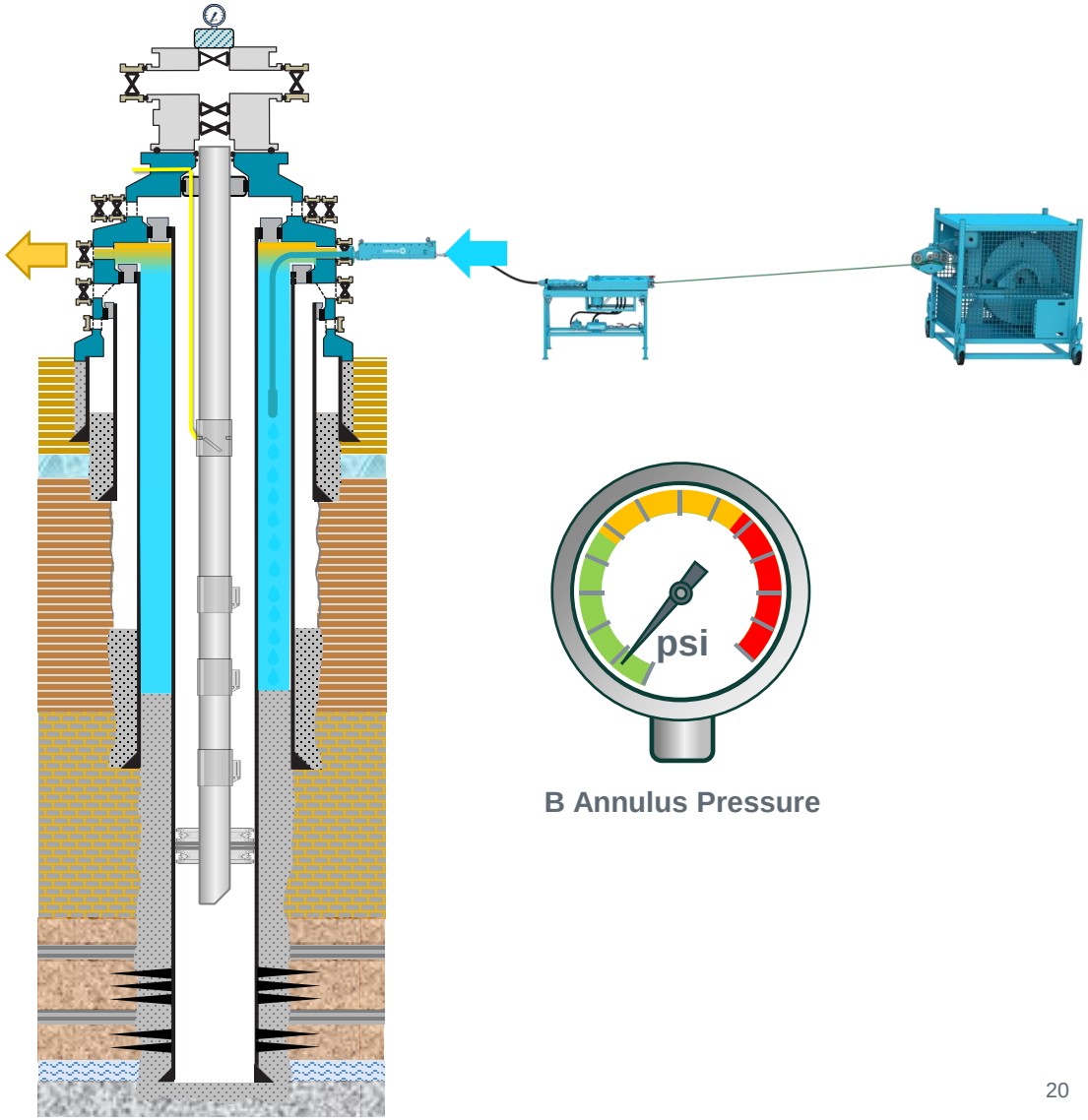

B Annulus Pressure

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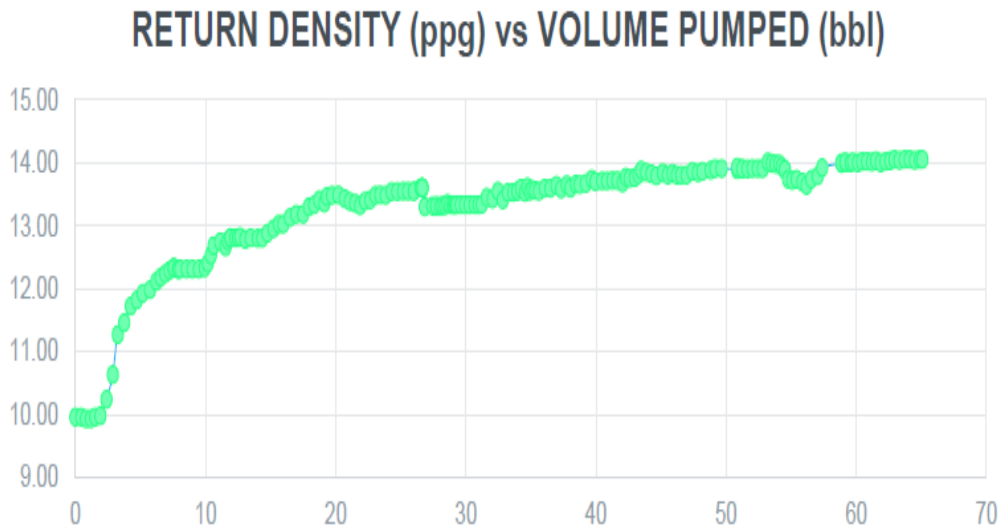
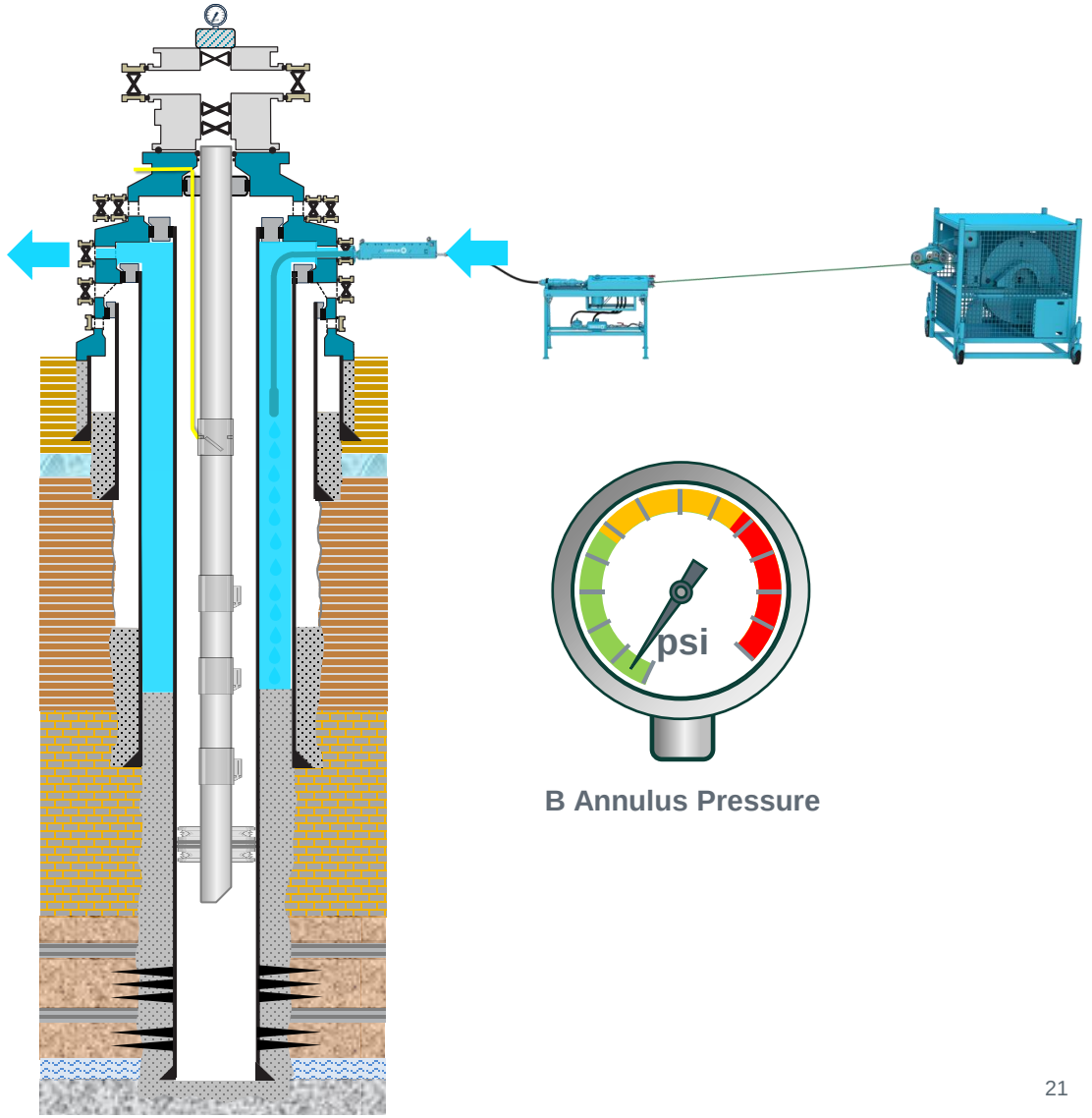
XK-1 Execution: Fluid Swap Sequence

Deployment

Brine Returns to Surface:

- Gradual Density Increase
- 14.1ppg Final Density





B Annulus Pressure

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XK-1 Execution: Fluid Swap Sequence

Objectives Achieved:

- 65bbls Brine Pumped
- 8 Pumping Days (12hr shifts)
- 21 Total Operational Days
- B annulus Pressure 160psi
- Well Brought Back Online

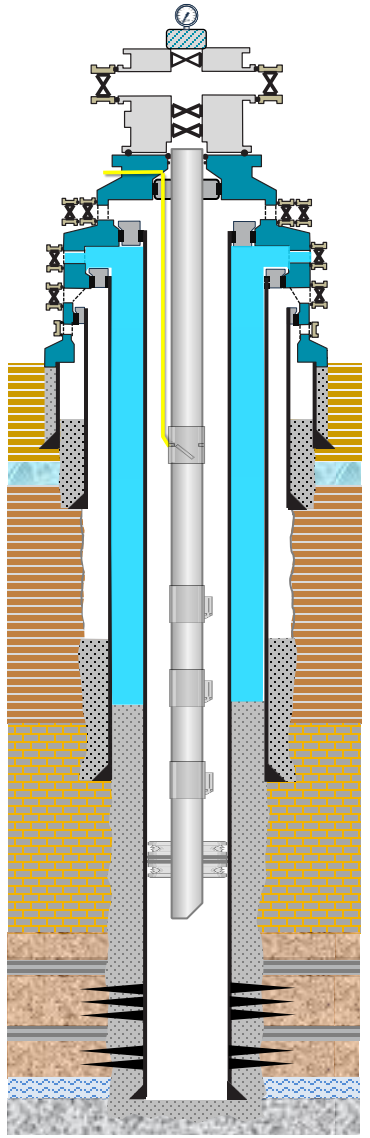
Enhancement

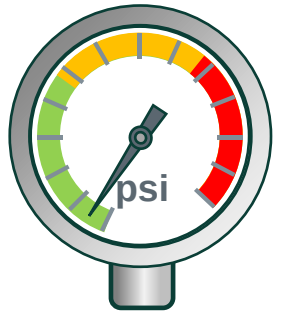
Bespoke solution

Well Integrity Remediation

Reduces operating costs

Increases asset value





B Annulus Pressure

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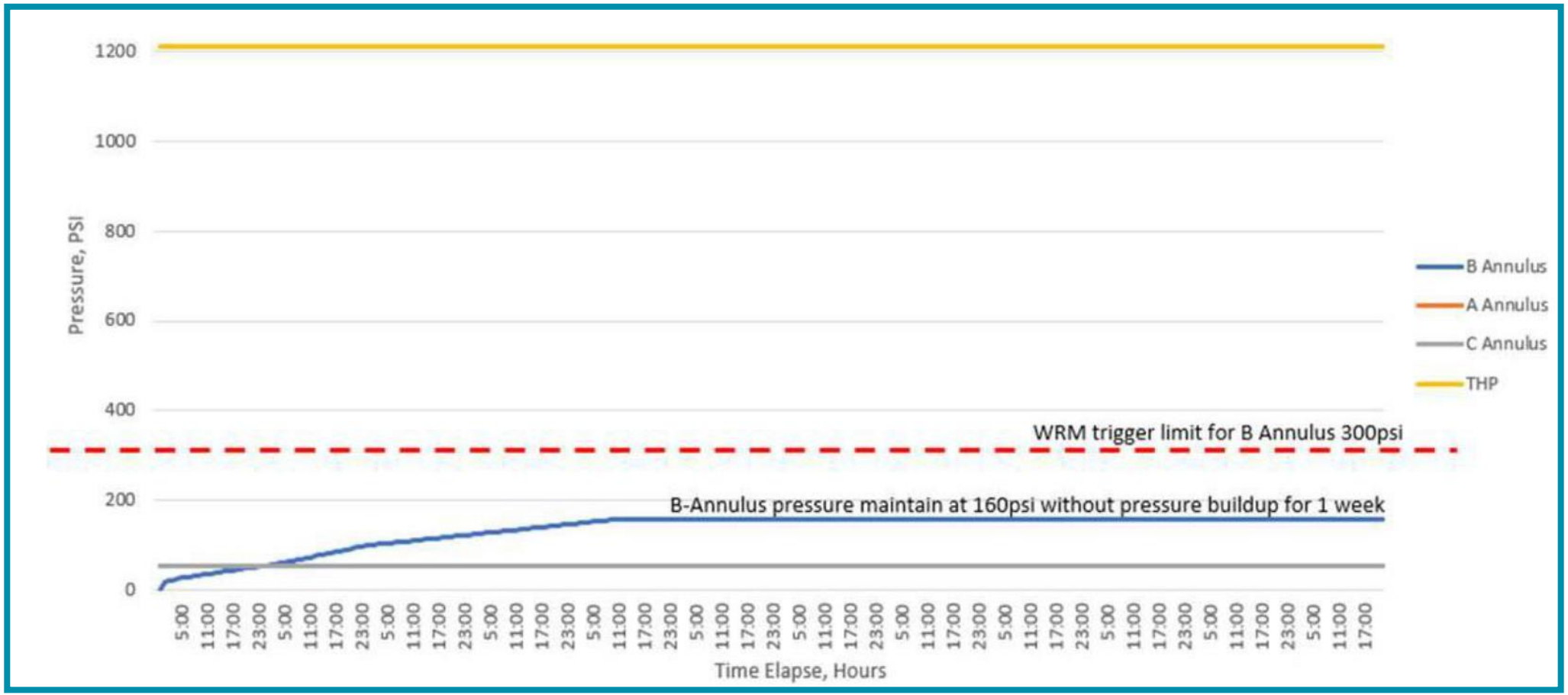
XK-1 Results: Sustained Casing Pressure Reduction

B-Annulus Pressure Monitoring Post Job



Enhancement

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Value to Client

SCP Reduced to Below Regulator Limits in 3 Weeks and Wells Brought Back On-line

> We, the Petronas Well Integrity team finally managed to rectify the sustained annulus pressure issue for this well after a series of past trials with other technologies and methods."
>
> Customer quote

Presentation end

Any questions?