PRACTICES FOLLOWED TO ENSURE “WELL INTEGRITY” DURING WORK OVER OPERATIONS & WELL COMPLETION IN OIL INDIA LIMITED
PRESENTATION COVERS

✓ Basic concept on Well Integrity, Barriers & types of Failures in wells.

✓ A road map to ensure well integrity in OIL.

✓ A Case study.
WHAT IS WELL INTEGRITY?

“Well Integrity is the design, installation, operation and maintenance of all the well equipment to a standard that ensures safe containment of well fluids (produced or injected) over the entire life of the well”

*Keep the hydrocarbons in the pipe!*
WELL INTEGRITY – INFLUENCING FACTORS

• Physical
  ✓ Well Life.
  ✓ Cumulative oil/water production.
  ✓ Completion types.

• Composition
  ✓ Nature of production and injection fluids.
  ✓ Suspended Solid Produced with well fluids.
  ✓ Water Cut

• Environment
  ✓ Nature of formation fluid behind casing.
  ✓ Pressures and temperatures.
  ✓ Flow rate & Regimes
WELL BARRIERS

✓ For Well integrity we need barriers which needs to be defined.
✓ Well barriers are envelopes which prevents fluids or gases from flowing unintentionally, from the formation into another formation or to surface.

BARRIERS CLASSIFICATIONS

Primary Barrier
Secondary Barrier
BARRIER DESIGN IN OIL INDIA LTD

SIGNIFICANCE OF WELL BARRIERS

- Two independent & tested barriers.
- If one of the barrier fails then all the activities in the well shall be directed towards restoring the barrier.
FAILURE OF WELL BARRIERS

✓ Surface Failure
   X Mass Tree & Annulus Valves, Tubing & Casing Hanger Seals, etc

✓ Sub Surface Failure
   Completion String, Casing, Cement behind Casing, etc

✓ Combine Surface and Sub Surface Failure
POSSIBLE LEAK PATHS-IN COMPLETION STRING (SUB SURFACE FAILURE)

- Tubing Hanger Seal
- Tubing & Connections
- TR SSSV Control Line
- Gas Lift Valves
- SSD
- Prod Packer
POSSIBLE LEAK PATH FROM CASING (SUB SURFACE FAILURE)

- Casing Hanger Seal – Leak to B Annulus
- Casing Leak – Leak to/from B Annulus
- Casing Leak – leak to/from Formation
- Cement Bond failure – resulting communication with other formation
ROAD MAP TO WELL INTEGRITY MANAGEMENT

Well Data

Inspection and Record Generations

Risk Assessment & Planning

Work over
ROAD MAP TO WELL INTEGRITY MANAGEMENT

Well Data
✓ Well Development Note
✓ Completions reports
✓ Other Reports (BHP, Hole Probing, fish details if any etc)

Inspection and Record Generations
✓ Visual Inspection
✓ Pressure Monitoring
ROAD MAP TO WELL INTEGRITY MANAGEMENT

Risk Assessment & Planning

✓ No Risk Well: No Failures.
✓ Medium Risk Well: Needs to repair on scheduled work over.
✓ High Risk Well: Require immediate action.
WORK OVER OPERATION

✓ Subside the well with kill fluid
✓ POOH Production string
✓ Casing scrapper trip
✓ Record Logs
✓ Restore integrity
BARRIERS DURING WORK OVER OPERATION

Primary Barrier
- Fluid Column

Secondary Barrier
- Casing
- Casing Cement
- Well Head Seals
- Annulus Vaves
- Drilling BOP

A Annulus
B Annulus
Barrier Test / Repair

- Testing primary / secondary Seals
- Casing Test & Repair
- Isolation Repair
TESTING PRIMARY SEALS

**CONVENTIONAL WELL-HEAD**
TESTING PRIMARY SEALS

CONVENTIONAL WELL-HEAD

Tubing Bonnet

Tubing Head Spool

Casing Valve

Bit Pilot

Secondary Seal

Test Port

Primary Seal

Annulus Valve

Isolation Casing

Production Casing

Plastic packing

injection port

Check valve

Casing Head

Housing

B

A
Casing & Isolation Repair

- Casing Repair
  - USIT Log
  - Casing Damage Hunting
  - Cement Squeeze / Casing Patch

- Isolation repair
  - CVL-VDL Logs
  - Cement Squeeze
Oil India Limited has three basic types of well completions based on flow, namely:

- Gas well
- Self Flowing Oil Well
- Artificial Lift Well
WELL COMPLETION

• Gas Well
  ✓ Premium Thread Tubing's
  ✓ Retainer Packer with extended Seal Bore
  ✓ Two Master Valve
  ✓ TR-SSSV (Tubing Retrieval Sub Surface Safety Valve).

• Self Flowing Oil Well
  ✓ Combination of P-110 & N/L-80 tubing.
  ✓ Hydraulic Packer or Mechanical Packers.

• Artificial Lift Well (Gas Lift Well)
  ✓ N-80 or L-80 tubing's.
  ✓ Completed with GLV & Packer.
COMPLETION equipments Checks/Tests at Workshop

• Gas Lift Valve & Mandrels
  ✓ Conventional GLM minimises chances of leak.
  ✓ Gas lift Valves and Mandrels hydro test.

• Hydraulic Packers
  ✓ The ball, seat & shear pins checked.
  ✓ Hydro test up to 200 Psi.

• Hook Wall Packers
  ✓ Function test of the HW Packers.

• X Mass Tree
  ✓ Function test of valves & Hydro test.
GAS LIFT VALVE & MANDREL HYDRO TEST ON WORKSHOP
HYDRAULIC PACKER HYDRO TEST ON WORKSHOP
Testing of Completion Equipments

- Packer with or without GLV’s
- X Mass Tree is Rig up
- Packer is set and hydro tested
CASE STUDY
INTEGRITY REPAIR

BRIEF HISTORY

✓ Development Oil Well Completed on March 2000.
✓ Initial Production, oil 92 klpd, Bean- 5 mm, FTHP - 3000 Psi, GOR - 122 scum/kl.
✓ April’ 2010, sharp decline with a high water cut was observed.
✓ The tubing punctured at 1200 m in to facilitate gas lifting.
✓ December’2011, existing perforations sand was plugged back using through tubing bridge plug (MPBT) & Perforated.
✓ During Testing the higher up sand the SITP-SICP-2300 Psi & Pressure Built was observed on 9 5/8” X 5 1/2” B-Annulus of 1150 Psi.
✓ Decided for urgent workover.
CASE STUDY - INTEGRITY REPAIR

- Recorded CBL-VDL
- The USIT log showed suspected casing damage in the range 1681-1685m, 1855-1860m, 2314-2315 m.
- Hi-Vis pill placed 2800 - 2470 m.
- Cement Plug placed 2390 – 2470 m.
- Using Hook Wall Packer
  Leak detected 1190 - 1247 m.
CASE STUDY - INTEGRITY REPAIR

- Casing Damaged in between 1190 - 1247 m.
- Decided for Cement Squeezed Job
- Hi-Vis pill placed 1255 - 1655 m.
- Cement squeezed into B Annulus Top Plug displaced up to 1165 at Max 1000 Psi on surface.
- Cement is cleaned up to 2317 m.
- A Positive at 1000 Psi is carried out and found OK
WELL COMPLETION – AFTER REPAIR

<table>
<thead>
<tr>
<th>From TH</th>
<th>Well Schematic</th>
<th>Description</th>
<th>Min ID</th>
<th>Max OD</th>
<th>DRIFT</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>13 3/8&quot;</td>
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<tr>
<td>9 5/8&quot;</td>
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<tr>
<td>5 1/2&quot; Casing</td>
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<td>GLVS and Gas lift Mandrels (07 nos)</td>
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AFTER INTEGRITY REPAIR THE WELL PRODUCED @35 KLPD with FTHP-1900 Psi.

<p>| Gas Lift Mandrel (Depth in MDRT) |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Depth</th>
<th>Status</th>
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<tbody>
<tr>
<td>1</td>
<td>598</td>
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<tr>
<td>2</td>
<td>1149</td>
<td>GLV</td>
</tr>
<tr>
<td>3</td>
<td>1637</td>
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<td>6</td>
<td>2777</td>
<td>GLV</td>
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<tr>
<td>7</td>
<td>3063</td>
<td>GLV</td>
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</table>

5 1/2" Boll Hyd Packer @ 3561 m
3625.0-3628.0 m (OPEN)
3634.5 - 3638.5 m (PB)
51/2" Float Collar @ 3715.7 m
5 1/2" Shoe @ 3742.5 m
THANK YOU
## LOG's OF THE WELL

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
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<tbody>
<tr>
<td>Cable Tension (TENS)</td>
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<td>4000 lbf 6000</td>
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<td>Head Tension (HTEN)</td>
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<tr>
<td>LEH-QT -200 lbf 1800</td>
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<tr>
<td>Calibrated Gamma Ray (GR_CAL)</td>
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<td>Casing Collar Locator Amplitude (CCL)</td>
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<td>CAL-YA -17</td>
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<td>Acoustic Impedance Average (AIAV)</td>
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<td>USIT-D</td>
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<td>Minimum (AIAV) USIT-D</td>
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<tr>
<td>0 Mrayl 10</td>
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<tr>
<td>Acoustic Impedance Maximum (AIMX)</td>
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<td>USIT-D</td>
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<td>Custom Normalization</td>
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<td>USIT - AIBK_SC USIT-D</td>
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<td>(Mrayl)</td>
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<td>Bonded</td>
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<td>CBL Amplitude (CBL) DSLT-H</td>
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<tr>
<td>Variable Density Log (VDL) DSLT-H</td>
<td>1200us</td>
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**Graphs and Data Visualization:**

- Graphs at different depths (1685, 1855, 1860) showing variations in various parameters.
- Color-coded data ranges indicating different mineral content or density anomalies.
LOG’s OF THE WELL
LOG’s OF THE WELL