Velocity string installation in deep live gas wells.

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• Presented by: Petroleum Development Oman, LLC; Halliburton HWO, RedSpider technology.
Agenda

- Introduction
- Background and History
- Challenges
- Technology
- Case Studies
- Summary
- Conclusion
- Acknowledgment
Introduction

A team effort between operator and Service & technology providers with a strategy to:

- Successfully install the deepest velocity string in live Gas wells with full Pressure control through a stand alone Hydraulic work-over unit.

- Solve industry challenge to snub Cr13 P110 hard material by combining specialized micro-grip technology and Hydraulic work-over.

- Single retrievable Packer/Hanger system.

- Safe design & procedures
Challenge

- Maintain two barrier pressure envelope.
  - No liquid throughout velocity string installation.
  - Pump out by N2 after releasing running tool from the set Packer.
Challenge

TBG WLL, SM13CRM-110, VAM TOP, 6.4#, 2.7/8IN

The tubing poses industrial challenges if deployed in snubbing operation.

Rig type/standard snubbing dies prone to slippage issues are banned for this tubing.
Challenge

Strategy to:
1. Run Lower grade (L-80 grade) in light mode.
2. Subsequently manufactured and tested non marking dies utilizing micro-grip technology in the USA.
Challenges

Design of a single retrievable through tubing Packer system:

1. Packer device capable of suspending 120,000 lbs.

2. Full deployment in Under-balance conditions.

3. Running tool and Packer system suitable for HWO operation.
Despite high strength requirement; a Single retrievable Packer system must pass through TRSSSV restriction of 4.313” and set inside 5-1/2inch 17ppf 13Cr P110 Tubing at 70 mtbf.

1. Design rating & size Challenge.

2. Shock Impulse loading after releasing the Running tool. (The string weight shifts from Heavy string weight ~100 kips to a snub or Negative weight and disconnects at 70 m from surface).

3. Stand-alone HWO unit is rated to minimum 340 K to be able to withstand the impulse load at surface.
Challenges

340 K Hydraulic work-over (HWO) stand alone
The minimum requirement of BOP (71/16” size, 10k rating) protection through the whole operation as shown.

The stack Provided

1. Safety and secondary protection
2. Redundancy at every step.
3. Stack up through bore size is compatible with both 2.7/8 & 2.3/8 velocity string tubing in use. It therefore prevents any possibility of buckling or seal loss.
Case Study

Case study Well 1:

**String Depth:** 4,500 m - 2.3/8" POP WEG SLEEV VAMTOP SS

**PIPE LIGHT STRATEGY:**

Use Halliburton standard dies to deploy Cr13 L-80 43 Joints of 2.3/8 & 70 Joints of 2.7/8 to cross balance point to heavy mode.

**PIPE HEAVY after 70 Joints of 2.7/8:**

Use WEATHERFORD MICRO GRIP TECHNOLOGY to deploy Cr13 P110 2.3/8 & 2.7/8 pipe.
Case study Well1

Packer Deployment:

The Packer 4.42 m long assembly was secured in the jack to allow jack to take a second bite without deploying the stationary slips was successfully implemented as per Halliburton procedure.

Top Photo: Weatherford micro grip slips and bowl.

Second Photo: Pup joint and packer made up at stationary slips.
Case Study

Case study Well1

Photo: 1) Equalization from zero gauge (atmospheric) to CITHP once Packer is stripped inside BOP stack using wellbore pressure.

Photo: 2) Packer Set by pressurization in stage above solid pistons in the running tool to activate setting sleeves.

No Liquid lost into well bore.
Case study Well 2

Implemented micro grip to snub
**TBG WLL, SM13CRM-110, VAM TOP, R3, 2.7/8 IN**

Learning: Possibility of premature setting.

A locking mechanism is required to reduce running tool sensitivity to HWO jack strokes.
Case Study

Case study Well 3

Interlocking mechanism added to the running tool at test bay to 5000 lbs loading.
Case Studies

Case studies Wells 3, 4 and 5

Learning:

Further installations in Oman; studies and tests in USA and UK confirmed safe implementation.

- micro-grip and tubing run.
- HWO Mechanical system including slip bowls during velocity string installations along with Hydraulic work-over system.
- Single through tubing packer system.
Summary

VS job performance

Well 1  Well 2  Well 3  Well 4  Well 5

Duration (days)

NPT

On job
Premium connection seal. QA/QC using JAM PRO technology latest version is extremely important at every step.

Connections is Inflow tested inside the BOP stack against CITHP prior to snub of each joint.

Photo: example cross threads and slippage Up/Down from QA/QC JAM)
Conclusion

- Pressure control envelope maintains two barriers all time.
- Redundant surface BOP protection.
- Effective 7.1/16 & 10 k stripping stack.
- Effective symmetric micro-grip technology
- Buckling guides to safeguarded all work windows.
- Premium VAMTOP to provide reliable primary barrier by JAM PRO technology.
- RedSpider Technology successfully provided PODP and a retrievable Packer/hanger system in under-balance live wells.
SUMMARY: Three main technology Provisions to make a successful Installation.

- Halliburton stand alone HWO unit and Micro grip Technology to deploy P110 Cr13 pipe
  Each of 4 slip bowls includes 3 dies X 4 (90 degrees offset) = 12 dies
- RedSpider Technology
- Tubing VAMTOP running services.
Successful installations of the world’s longest velocity strings using P-110 Cr13 jointed tubing continued to be achieved running in excess of 4,500m on a single retrievable string packer through a Hydraulic Work-over Unit.

Another 5-6 velocity strings is already in 2010 plan.
Big thanks to:

All participants in the successful longest 5 velocity strings.

- **Petroleum Development Oman LLC**,
  - Koper Mark - Team leader.
  - Maimani Salman - Team leader.

- **Red Spider Technology FZE**
  - Bruce McLeod – ME regional manager.
  - Bruce Gavin-Engineering.

- **Halliburton Worldwide Limited.**
  - John Brumfield- HWO coordination and Production enhancement
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Thank You All Very Much.

Stage For Questions.