



PULLING THE PLUG

**Andreas Fliss, Elisabeth Norheim
and Roar Pedersen, Archer, Norway,**
explore the use of retrievable bridge plugs
to optimise well operations.

Well integrity is concerned with the safe and reliable containment of all well fluids throughout the life of a well, including while drilling, running completions and well intervention. Operators are constantly looking for the safest and most efficient methods to be one step ahead of the game with better technologies.

As the industry recovers from the downturn, the challenges associated with improving and maintaining well integrity with operational efficiency, prompt results, and cost savings are all of the utmost importance. New technologies need to be able to deliver better wells by extending well life, maximising well performance and minimising environmental impact.

Dual plug one-trip solution

Archer's dual plug VAULT™ system enables two Retrievable Bridge Plugs (RBPs) to be installed in one run, with the ultimate goal of reducing operational time and cost. The system has been deployed in the North Sea several times for major oil and gas

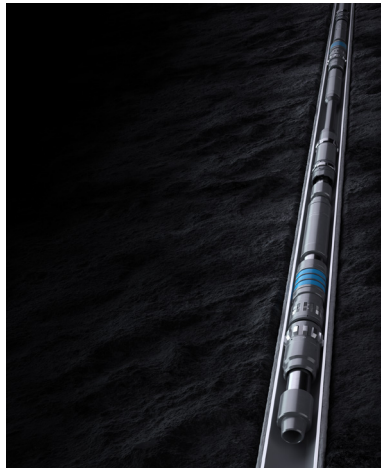


Figure 1. Vault – dual plug system.

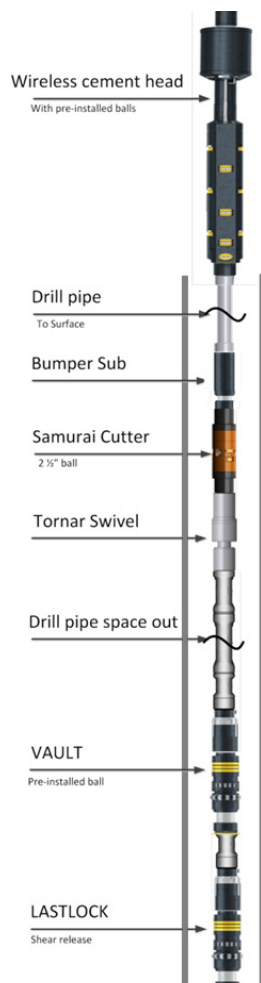


Figure 2. Case study 2 – tool string combination run.

operators, saving significant rig time while reducing wellsite handling and subsequent operational risk.

The system is tailor-made for several applications, such as temporary plug and abandonment (TA), well suspension, setting well barriers, and detecting leaks. This solution is ISO 14310 V0 certified and available in 9 5/8 in., 10 3/4 in. and 13 3/8 in. casing sizes.

A combination of sizes can be run, where the lower plug can be either of the existing LOCK™, SPARTAN™ or SPEARHEAD™ plugs available in Archer's plug portfolio.

Key capabilities include:

- ▶ ISO 14310 V0 rated gas-tight seal.
- ▶ Dual plug one-trip system for setting and retrieving.
- ▶ No setting weight needed below and limited weight needed above.
- ▶ High differential pressure.
- ▶ Equalising feature across VAULT plugs in case of trapped pressure below.
- ▶ Combination runs.
- ▶ Reduced red zone activity.
- ▶ High tripping speed.
- ▶ High heave limit.
- ▶ Millable.

This solution is based on the company's existing plug technology, driven by the LOCK plug, a gas-tight, zero leakage RBP.

Remote operations

Archer's Integrated Operations Center has played a part in delivering faster, safer and more cost-effective plugging operations in the North Sea. It utilises real time data and new technology to enable collaboration between onshore support and offshore teams. Real time data can be transferred over long distances, removing the physical barrier between expert onshore support teams and offshore execution teams. Integrated operations reduce offshore personnel-on-board (POB), therefore ensuring more streamlined and economical operations.

Other plug solutions

The company's plug solutions are designed to provide cost and time savings for a wide range of applications including managing well integrity, securing well suspension, plug and abandonment (P&A), and pressure testing. Two examples are TIMELOCK™ and LASTLOCK™. The former is designed for short, medium and long-term suspension and harsh well conditions – it is V0 rated, retrievable, resettable – and the latter is designed for total security in permanent well abandonment and harsh well conditions.

Case study: North Sea operator

Challenge

The recompletion of wells on the Norwegian continental shelf required the wells to be temporarily suspended prior to running a Xmas tree and upper completion.

Archer had installed several RBPs for a major operator; historically, the majority of the wells have been temporarily suspended with two RBPs, with one deep and one shallow.

The conventional method for these suspensions has been to run in and install a deep set plug, pull out of hole (POOH) with the running tool, then run in hole (RIH) and install a shallow plug prior to POOH with the running tool.

These conventional operations have been made increasingly efficient over the years. Optimising procedures based on

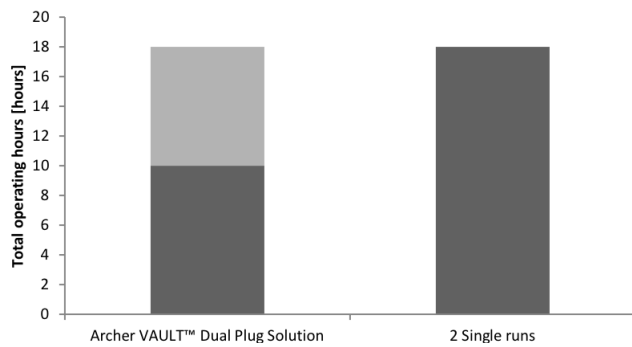


Figure 3. Typical operating hours for Archer VAULT dual plug solution versus two single runs. Lighter grey area shows time saving.

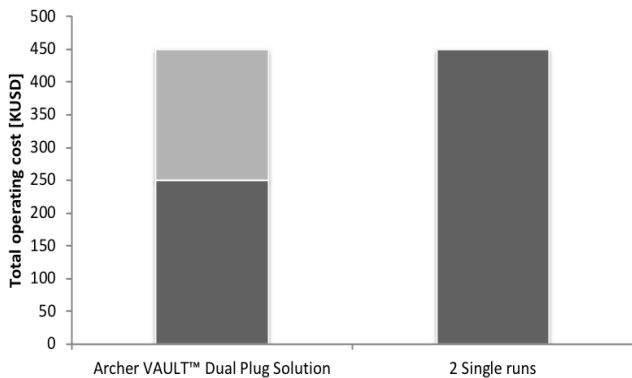


Figure 4. Typical total operating cost for Archer VAULT dual plug solution versus two single runs (including rig cost). Lighter grey area shows cost saving.

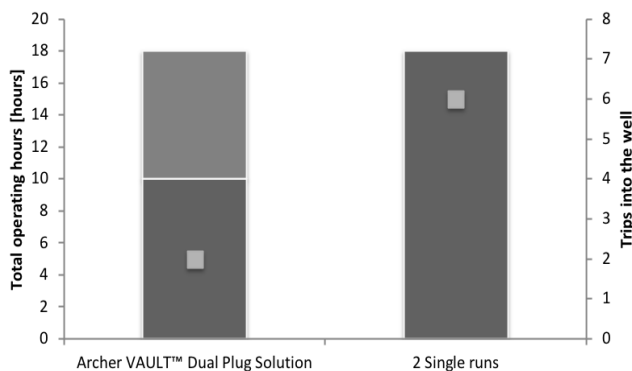


Figure 5. Typical total operating time for Archer VAULT dual plug system combination (single trip) versus individual trips into the well (three trips). Lighter grey area shows time saving.

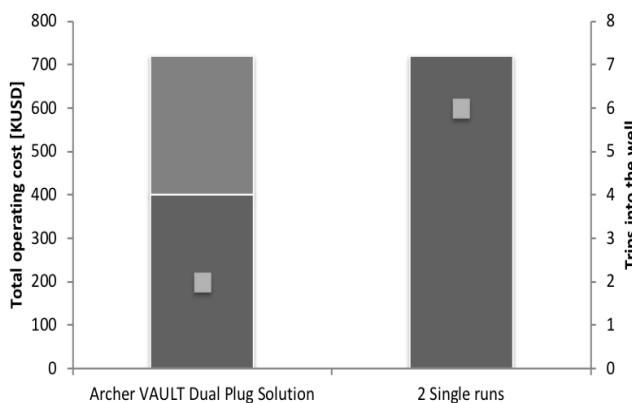


Figure 6. Typical total operating cost for Archer VAULT dual plug system combination (single trip) versus individual trips into the well (three trips) including rig time cost. Lighter grey area shows cost saving.

experience transfer and lessons learned, improvements to equipment and a focus from the operators to increase rig efficiency have driven this development.

Based on the increased need for cost saving over recent years, Archer was challenged to come up with a solution to further reduce the time spent on these suspension operations. In addition to bringing further time savings into plug operations, the operator also wanted Archer to consider the possibility of retrieving the wear bushing in a combination with running the suspension plugs, something that was originally done on a separate run.

Solution

As the standard operation had been optimised continuously over the years, additional substantial time savings based on utilising existing equipment and technologies could only be achieved through combining operations.

The VAULT dual plug system made it possible to set two RBPs in just one run. A standard TIMELOCK RBP was used for the deep barrier, similar to what is done in conventional operations, while the VAULT RBP was utilised as the shallow barrier. Both RBPs were RIH on the same trip.

Operationally, the upper VAULT RBP is disabled while setting the lower RBP, allowing the operator to set the lower RBP per the standard procedure, treating the upper RBP as part of the DP. Having set, tested and disconnected from the lower RBP, the VAULT RBP is positioned at setting depth and activated by dropping a ball and building pressure in the DP. The VAULT RBP can now be set per the standard procedure, with right hand rotation and downwards movement. The running tool for the lower TIMELOCK RBP is then hung off below the upper RBP.

The VAULT dual plug system also allows retrieval of both plugs to be performed in a single run.

A multi-utility tool (MUT) was incorporated in the running string to also pull the wear bushing in the same run, prior to setting the plugs.

Result

After introducing the VAULT dual plug system, the number of runs was reduced from three to one.

Both plugs were successfully installed and wear bushing retrieved in a single run. Retrieval of both plugs was also performed in a single run when the Xmas tree and BOP had been installed.

For the first two jobs performed, the time saving was estimated by the operator to be 9 hrs of rig time and the operator has recommended the system for further use internally.

Depending on setting depths and rig efficiency, further time savings can be achieved utilising the VAULT system.

Case study: combination runs

Challenge

As part of a planned slot recovery, a major operator on the Norwegian continental shelf had planned to cut a 10 ¾ in. tie back, install a shallow barrier, nipple down BOPs, retrieve the shallow barrier, pull the seal assembly, pull the tie back and pressure test the 13 ¾ in. casing in six separate runs. Archer was challenged to come up with a solution to minimise the number of runs and reduce the rig time.

Solution

With a 10 ¾ in. VAULT RBP and 10 ¾ in. LASTLOCK Plug – run in combination with Archer's Samurai Casing Cutter, Tornar Swivel

and the Wireless Controlled Cement Head (WCCH), the recommended number of runs was reduced to two.

Planned operation

Run 1

A LASTLOCK plug, modified with a straight pull release, was RIH with a VAULT RBP spaced out above, and followed by a Tornar Swivel and a Samurai Cutter (Figure 2). The wireless controlled cement head was preloaded with a ball for activation of the Samurai Cutter. The LASTLOCK plug was set and while still attached to it, set down weight in order to activate the Tornar Swivel and drop a ball to activate the Samurai Cutter. The tie back was then cut before picking up and shearing free from the LASTLOCK plug. The VAULT plug was then positioned at depth and installed as a temporary barrier during the nipple down of the BOP and XMT.

Run 2

The plug was RIH to release the VAULT RBP and Seal Assembly. The VAULT RBP was reset above the cut in the tie back, and the upper tie back portion was pulled to surface using the VAULT RBP as a spear.

Result

Operations were carried out as planned with the exception of pulling the tie back in run 2. The VAULT RBP was reset in the tie back and 660 000 lb/300 metric t pulled without freeing the tie back. Due to ovality, additional cuts were required to free the tie back. In reality, the proposed solution and actual operation saved several hours of rig time.

Dual barrier applications

The system enables operators to deploy two single RBPs in a single run, reducing surface handling and round-trip times. The total time saving depends on the well and rig scenario but typically between 12 to 24 hrs of rig time can be saved. For a typical offshore scenario with a MODU the daily spread rate can be range from US\$500 000 to US\$1 million. The time savings delivered through Archer VAULT dual plug RBP systems installed through a MODU can amount to US\$250 000 to US\$1 million per deployment.

Combination runs/application

The system also enables operators to combine activities and applications into a single run requiring RBPs, hence reducing the number of trips into the well. This again reduces surface handling and round trip times. The total time savings depend on the well and rig scenario but typically between 6 to 18 hrs can be saved for each trip avoided. For a typical offshore scenario on a fixed platform derrick the daily spread rate can be estimated to US\$150 000 to US\$300 000. The time savings delivered through the VAULT dual plug RBP systems installed through such a fixed platform can amount to US\$50 000 to US\$225 000 per deployment.

Summary

The company's VAULT dual plug RBP system, which can set and retrieve two RBPs in a single run, is field proven to improve HS&E by reducing pipe handling time and cost by eliminating runs.

It also enables the combination of plug running with other applications during drilling, completions, slot recovery and well abandonments, to reduce the overall number of trips into the well and create efficiency improvements and subsequent cost reductions. ■