

Deep Dive into Shallow Wells

Best practices for successful completion system installation and stimulation in shallow wells

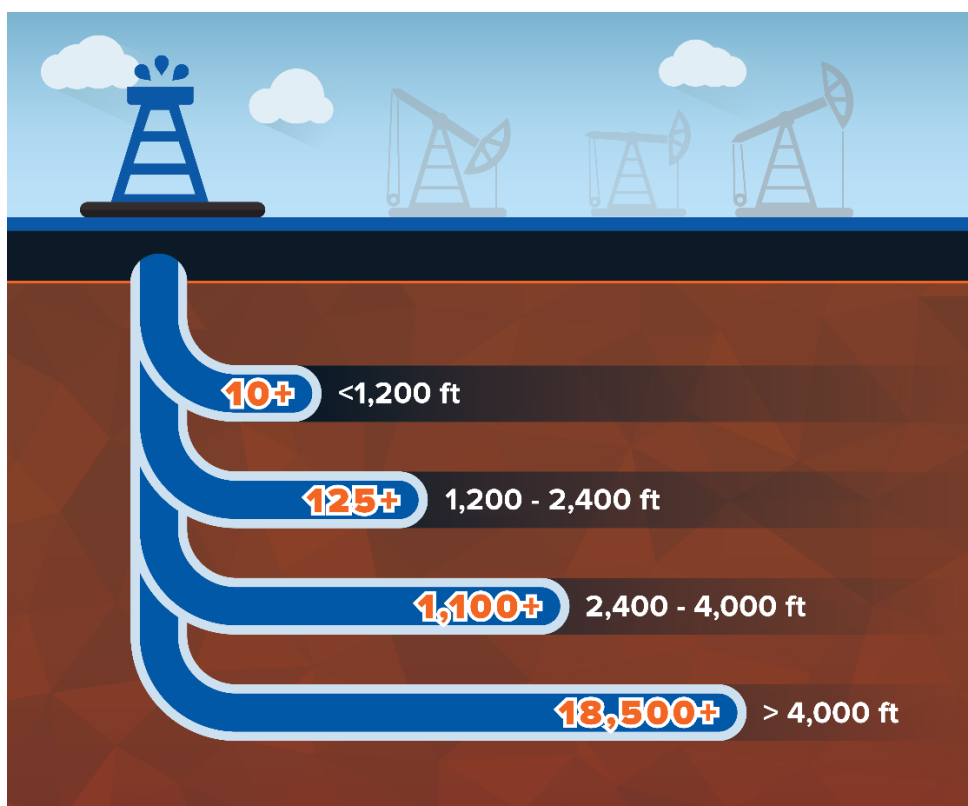
Drilling and completing shallow wells can pose unique challenges. With the horizontal length of the well typically much greater than the true vertical depth (TVD), there are risks that need to be considered to ensure the lower completion will reach the planned total depth (TD).

Packers Plus has installed completion systems in more than 19,500 wells worldwide. This extensive run history includes more than 1,200 installations in wells with a TVD of less than 4,000 ft (1,219 m). Over the past 20 years, Packers Plus has developed a robust set of best practices to ensure that each system reaches the planned TD. These best practices are particularly important in shallow wells to maintain safe and efficient operations, and minimize unnecessary downtime.

Packers Plus is at the forefront of the multi-stage fracturing industry with innovations in downhole technology, manufacturing capabilities and processes, world class engineering, well design and specialized field engineers. The combination of these innovations and expertise has enabled Packers Plus to supply fit-for-purpose completion systems with the highest level of excellence in the industry.

FOUR BEST PRACTICES

Packers Plus systems have been installed in wells with a TVD as shallow as 1,042 ft (317 m) and as deep as 21,627 ft (6,592 m). Well depth is an important factor when designing a completion system and ensuring that specific challenges can be overcome during installation.



1. Torque and Drag

During the planning phase, Packers Plus well design engineers use a specialized simulation program to analyze the proposed completion string and understand how it will fit into the designed well path. A tortuosity factor is added to the designed well path to simulate the worst case scenario and try to account for unexpected doglegs that may occur during drilling. Using the extensive experience from installing downhole tools in more than 19,500 wells, the design engineers will analyze the simulation results and predict if the system can reach TD as designed or if additional options need to be considered.

2. Open Hole Drift Run

Once the well has been drilled to TD and the hole is stable, liner installation operations can begin. The first step is completing a clean out trip with a drift assembly. This assembly is designed to mimic the stiffest part of the tool string and provides a good indication of how the tools will fit into the well. The drift assembly ensures the well has been drilled to the intended gauge, while also enlarging any tight sections encountered in the wellbore to allow the completion system to reach TD as safely and efficiently as possible.



3. Drilling Options

Some operators use slant drilling rigs to start drilling at 45 degrees right from surface rather than drilling vertical to start and kicking off hundreds of meters below surface in the desired trajectory to transition to the horizontal wellbore. This change in drilling methodology could eliminate the need for a push/pull machine, depending on the well construction and reservoir depths.

4. Flotation Sub

The AeroSTAT™ Glass Barrier Sub allows for the tool string to be run in the well with no fluid below the glass barrier sub. This creates an air chamber in the liner, which increases the buoyancy of the liner and reduces the effective friction during installation. The reduced overall friction helps the liner reach TD in shallow horizontal wells with the limited available tubing weight.



STACKFRAC MULTI-STAGE COMPLETION SYSTEM

The StackFRAC® Multi-Stage Completion System was developed in 2001 and the innovative technology has since been successfully run in a variety of applications globally. From high pressure multi-stage fracturing and high temperature geothermal applications to efficient degasification of coal seams, Packers Plus has worked with operators around the world to provide fit-for-purpose solutions for their unique challenges and applications.

The StackFRAC system is designed for open and cased hole completions to allow for accurate placement of proppant and acid stimulation treatments, hydrocarbon production, wellbore testing and water shutoff. The StackFRAC completion system includes open hole packers and ball-activated sleeves that are selectively opened with actuation balls pumped from surface. The tools are available in a variety of sizes, metallurgies and elastomers, enabling each well design to be customized to maximize the potential of each desired target.



Components of the StackFRAC System

Open Hole Packer

The RockSEAL® II open hole packer is a hydraulically set mechanical packer. It features a dual-element design to provide effective and reliable zonal isolation in a variety of wellbore conditions and formation characteristics. The packer's short length and minimum outside diameter provide ease of installation, ensuring deployment to the desired TD.

Ball-Activated Sliding Sleeve

The FracPORT™ sleeve is a ball-activated injection/production port. It is run between packers to allow specific zones of the wellbore to be stimulated. The sleeve can also be closed using a shifting tool, offering the flexibility to open and test specific zones, and shut off production from undesired zones.

Hydraulic Sleeve

The Hydraulic FracPORT sleeve is a hydraulically activated injection/production port used as the first stage of each StackFRAC system. The Hydraulic FracPORT sleeve opens at a specific tubing pressure, eliminating any need for intervention to begin pumping operations.

Circulating Sub

A Toe Circulation Sub (TCS) is installed at the toe of the system to control the flow between the completion tool string (liner) and the annulus. The TCS is kept open while running the liner in the well to allow for circulation of fluid through the liner. Once the liner has reached the desired TD, a ball is pumped from surface to close the TCS. With the TCS closed, the packers can be set and the hydraulic sleeve can be opened using only tubing pressure.

TWO SHALLOW WELL CASE STUDIES

1. Shallow Well Installation with Push/Pull Machine

Two wells completed in Canada provided a unique challenge due to their shallow TVD of only 1,050 ft (320 m) and a TD of 2,297 ft (700 m). With the horizontal length of the well greater than the TVD, there were risks that needed to be overcome to ensure the 5-stage StackFRAC completion system could be installed to the planned TD.



Careful pre-job planning was conducted to find a solution that would provide the operator with confidence that the liner would reach TD. A risk analysis was completed to minimize or eliminate steps that added risk to the operation. A series of torque and drag simulations were completed, which showed the lower completion would require more weight than just the weight of the liner to reach TD. A push/pull machine was put in place, allowing the drilling rig to add additional weight by pushing from surface. This proved to be effective and the last seven joints were pushed in the hole to reach the planned TD, as expected from the torque and drag simulation.

Once the completion system was installed and the open hole packers were set, the hydraulic fracturing stimulation began. The hydraulic stimulation was pumped continuously allowing the operator to take full advantage of the efficiencies added by the StackFRAC completion system. All five stages were pumped successfully in less than four hours.

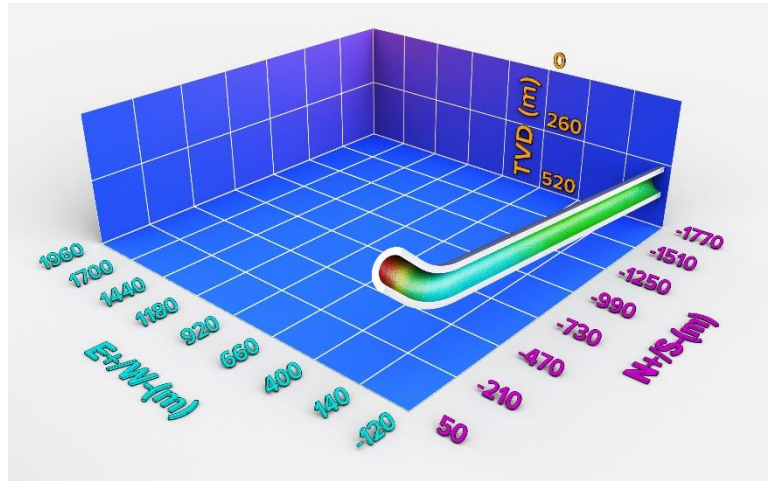
2. Degasification of a Shallow Coal Seam

An operator required assistance with the degasification of a coal seam and reduce the time between drilling the well until the coal could be safely mined. Multiple wells were required due to the large area that

needed degasification before mining operations could begin. To minimize drilling costs, the operator wanted to install the maximum number of stages in a horizontal wellbore to degasify the greatest area possible.

Packers Plus and the operator worked together to design the depth and the number of stages in the well to ensure the completion could reach TD based on the torque and drag simulation.

A 23-stage system was installed in the well, which targeted a coal seam that had a TVD of 1,260 ft (385 m) and a TD of 6,724 ft (2,050 m). The system was installed successfully, giving the operator confidence to continue using the StackFRAC system to realize both cost savings and improve safety at the mine site.



CONCLUSION

Drilling and completing shallow wells poses unique challenges. With the horizontal length of the well typically much greater than the TVD, there are risks that need to be considered to ensure that the lower completion will reach the planned TD.

Packers Plus has installed completion systems in more than 19,500 wells worldwide, including more than 1,200 installations in wells with a TVD of less than 4,000 ft (1,219 m). Through this experience, a robust set of best practices has been developed to ensure that each system reaches the planned TD. These best practices are particularly important in shallow wells to maintain safe and efficient operations, and minimize unnecessary downtime. Some of the best practices include:

- Torque and drag analysis
- Open hole drift run
- Wellbore drilling techniques
- Flotation sub implementation

WHITE PAPER

Packers Plus is a completion technology company committed to providing high quality solutions for a variety of applications, including cemented and open hole liners, high pressure / high temperature (HPHT), multi-lateral, onshore and offshore wells. To deliver this technology to the field, knowledgeable and experienced specialists provide customized solutions to clients around the world and are dedicated to ensuring the success of every well at every depth.

Explore more solutions, case studies, and white papers at packersplus.com.