After years of decline, well completion activity is up in most US unconventional plays. Until this renewed increase in activity, the drastic reduction in completed wells led the number of DUC wells (wells drilled but not completed) to rise significantly. Improved oil prices have now made these DUC well inventories more economically viable given that the cost to complete and bring a DUC well online is only 60 - 75% of the cost of drilling and completing a new well. This is the driving force behind the recent spike in well completions across much of the US unconventional market.

Well completion efficiency and effectiveness are the driving forces behind decisions regarding how unconventional wells will be constructed and fracture stimulated. With DUC wells, these completion decisions matter just as much, if not more, due to their age. Wells that were preplanned for more efficient multi-stage fracturing techniques, such as ball-drop fracturing operations, give operators an advantage by driving efficiencies up and improving utilisation of the resources required.

**Completions tools reliability**

One of the challenges voiced by operators for their DUC wells is the reliability of hydraulically activated toe sleeves and ball-activated fracturing sleeves. Both of these systems are initially chosen by completions engineers to provide improved efficiencies in their operations. Toe sleeves are installed in most cemented, horizontal unconventional wells as a means of providing an injection point on demand when fracturing operations are ready. The initial injection point provides a means of pumping down the first wireline-set fracturing plug and perforation string. Ball-drop fracturing sleeves are primarily installed in openhole completions with hydraulically activated or swellable openhole packers to provide zonal isolation. Unless employing cement for zonal isolation, ball-drop sleeve installations are often left with an open path in the toe of the well and do not need a toe sleeve.

Each of the above completion applications are at an increased risk of not performing as desired in ageing DUC wells. For these systems to achieve the original goals of improving completions efficiency and effectiveness, they have to perform as planned. To illustrate, consider how these ageing DUC wells benefitted from having reliable equipment installed that ultimately delivered the efficiencies planned.

**Case study – Eagle Ford**

Unconventional operators in the Eagle Ford shale play of southern Texas, employ hydraulically activated systems in the toe of their wells to first enable a casing integrity test, and then provide an initial flow path for reliable pump down completion operations. The RapidStart Initiator casing test (CT) sleeve system provides for a true casing test with the added benefit of a low pressure...
shear setting and time-delayed opening of the internal sleeve to establish injection to the formation. Nominally, a 10,000 psi casing test can be achieved in 30 minutes, with the sleeve opening on its own as pressure remains applied. The mechanical nature of systems such as these may lessen their reliability in harsh well environments after prolonged exposure. A major operator in the region had reliable results with their use of RapidStart initiator CT systems. Two recent DUC wells were completed 32 months after the initial installation. The sleeves opened exactly as prescribed and allowed them to continue operations without delay – a testament to the reliability of this sleeve system.

Case study – Bakken

Ball-drop fracturing sleeve systems, most often deployed with openhole well isolation provided by hydraulic or swellable packer systems, are known for enabling efficient fracturing operations. The Bakken’s application of ball-drop fracturing sleeve systems peaked around 2014 with up to 60% of wells applying the technology. At that time, average stage counts were 35 to 50 stages.

DUC wells with ball-drop sleeve systems are at increased risk of not functioning as desired. Like the toe sleeve applications, these mechanical systems rely on accuracy and reliability of the internal mechanical systems to perform as desired. When the sleeves do not function during ball-drop operations, the most common observation noted by operators is sleeves that simply do not open. This causes NPT while the pressure is cycled up and down in an effort to force the sleeve open after ball landing. Operators have noted that sometimes these efforts are futile and necessitate intervention to remedy the issue, waiting for balls to dissolve and/or possibly skipping the zone altogether.

The RapidStage® sleeve system, in conjunction with Swellpacker® or ZoneGuard® isolation systems, have been designed to provide the fracture placement accuracy, reliable operation, and zonal isolation that operators require. The particular Bakken operator in this case study was a primary user of RapidStage and Swellpacker systems for completions. Some of their ball-drop wellbores remained uncompleted until early 2017. The longest of the DUC wells was 410 days from initial installation until the successful fracturing operations were completed – setting a record for these systems in the Williston Basin. All of the surrounding wells completed in the same time period were also ageing DUC wells, and each were completed with overall 99% ball landing accuracy and zero issues opening the sleeves. Two of the subject wells were completed 329 and 342 days after installation. A maximum treatment efficiency of 16 stages in a single 12 hour period was achieved during fracture stimulation of these two 50 stage wells. This efficiency would be unattainable without the proven reliability of these systems to land the balls accurately, open immediately, and provide the necessary zonal isolation to place the job as planned.

Meeting operator demands

Operators will always require that the products and services they purchase be reliable while delivering on the efficiency and effectiveness that is expected. They will look to optimise their completions at the same time as they decide which of their assets make the most sense to target at any given time. When it comes to DUC wells, the reliability of these systems will continue to be a principal requirement and means of reducing risks in operations, especially if inventory levels are expected to stay high or at least fluctuate to higher levels during market cycles. Hydraulically activated toe sleeve systems, such as the family of RapidStart Initiator systems, are here to stay and customers are able to rely on these systems to provide the value expected. For peak efficiencies and reliability of ball-drop fracturing operations, customers are also able to achieve the confidence they need with reliable performance from their installed sleeve systems. For operators that continue to value some of the flexibility and confidence that plug-and-perforate completions offer, the continuing advancement of dissolvable plug technology applications will achieve additional value in bringing DUC wells online efficiently and with reduced service intensity by reducing, delaying, or eliminating altogether the wellbore cleanout requirement and risk.

Summary

The US unconventional oil and gas industry will continue to achieve a global advantage by being able to swing production quickly from its core areas when the market favours more production. A key part of being able to do this is to accomplish rapid increases or decreases in industry activity – something that with current completions methods requires ramping up and down a very large service sector and supply chain. DUC wells may play an important role for operators looking to benefit from producing when commodity prices are favourable, and saving cash when they are not. Their ability to shift as needed, while relying on a service sector and supply chain to also react in a timely manner, would benefit from having to coordinate fewer resources overall. Ball-drop completions enable efficient and effective fracturing operations that achieve the same goals in less time. This drives up service company and equipment utilisation, requires less and equipment overall with reduced service intensity, utilises less water, and enables intervention-free production to get wells online faster. The peak efficiencies and reliability that these systems can deliver would benefit operators that carry higher DUC well inventories going forward to improve their ability to carry out high-activity cyclical operations in a supply limited environment. Ball-drop sleeve systems are capable today of delivering on nearly every objective set forth by operators, especially in hybrid applications in conjunction with plug-and-perforate methods. Further advancement of these systems and multi-well pad fracturing operations will continue to achieve the expanding objectives of completions engineers and expectations of agile unconventional well operators meeting the changing demands of a global economy.