GOING AROUND THE BEND

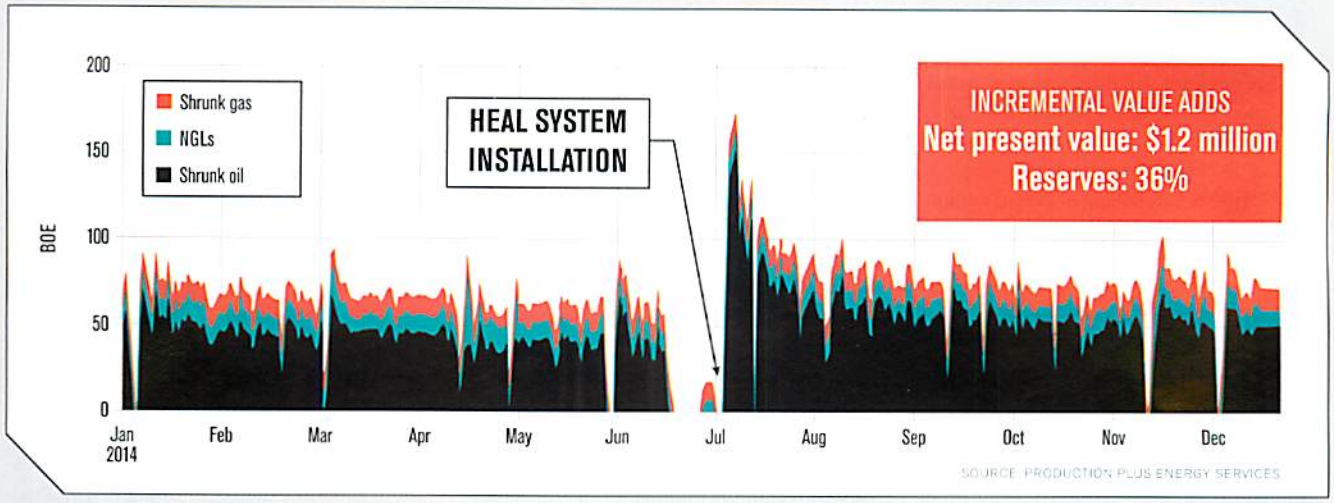
Combining two artificial lift systems solves the horizontal pumping challenge

Very soon after the multi-stage fracturing revolution began a decade ago, operators discovered that traditional rod pumps lost efficiency when forced around the bend and into the horizontal leg of a modern well.

"The load on the pump-jacket surface went up materially, and so we had to run larger artificial-lift equipment to compensate for that," says Jeff Saponja, chief executive officer at TriAxon Oil and Production Plus Energy Services. "The rod pump that has been around the past 50 or more years is really designed to run vertically, and it does not like going around the bend."

One issue, according to Saponja, is that horizontal wells do not allow operators to "sump the pump." This refers to running the pump below the reservoir in a vertical well so as to maximize production by pumping off the well to the lowest pressure possible, while also providing the capacity to remove any solids that come along with production before entering the pump.

"There is no sump now because we turn the wellbore into the reservoir horizontally. A rod-pump configuration with >



no sump is one of the reasons [the downhole pump] has lost its efficiency in a horizontal-well configuration. All flow from the horizontal, which can include solids and gas, enters the pump directly, causing run-time challenges and a reduction in pump operating life."

To make matters worse, solids naturally accumulate at a 30-65-degree slope region of the wellbore's bend or heel section—exactly where the downhole pumps are commonly positioned. Saponja says: "We end up creating a situation where we have very poor run times due to gas interference, we can't pump the well off to maximize production and we have higher workover frequencies because of solids damage."

Working in a deep Viking light-oil reservoir a couple years back, TriAxon realized these big, long horizontals are actually very good natural separators for oil and gas entering the wellbore. When they separate, according to Saponja, the resulting flow out of the horizontal wellbore becomes messy and inconsistent. Inconsistent flow from the horizontal wellbore means at times the downhole pump sees all gas or all liquid or highly variable rate combinations of both. Inconsistent flows also create mechanical wave action along the horizontal, migrating solids to the bend section.

"No artificial-lift system likes messy flow, and so our hypothesis was that maybe the solution for successfully artificially lifting horizontal wells is to regulate flow out of the horizontal to smooth it out and stabilize it. We observed from interruptions to producing wells—for example, a short-term power failure—that the flows became even more messy and inconsistent, which resulted in even greater inefficiencies."

Saponja and his team actually knew from underbalanced drilling practices how to smooth out inconsistent flows, and they could therefore resolve inconsistent flows of the horizontal using underbalanced drilling techniques.

He says, "We also asked ourselves another key question: why is everyone trying to solve artificial lift with one system—either a rod pump, ESP [electric submersible pump], gas lift or screw pump? Then we asked the question: why can't we run two different artificial lift systems in sequence and have them work harmoniously?

"The absolute king for artificially lifting the vertical section of the well is the rod pump, so let's leave it alone. It is happy in the vertical, it's efficient, it's low cost to maintain, and operators at surface are familiar with its operation. It just does not like being around the bend."

The team then focused on the most efficient artificial lift system for the bend—a system that provides maximum drawdown and run time, is tolerant to solids and provides the ability to regulate inconsistent flows.

In November 2013, TriAxon established Production Plus to develop the patent-pending HEAL System for the horizontal well's bend section. With no moving parts, a large solids sump and advanced-separation technologies that bridge two different artificial-lift systems, this solution makes the horizontal "think" it is a sumped vertical.

By smoothing out the flow, controlling damaging solids and placing the rod pump out of the bend section, pump efficiencies increase dramatically and jack loadings reduce materially.

"We pass on to the rod pump mostly gas and solids-free liquid in a smooth manner. How happy is the rod pump when it is seeing very consistent liquid? It is very happy," Saponja says. "All of a sudden, our run times went from 70-80 per cent to nearly 100 per cent."

First installation of the HEAL System was in March 2014. Pre-installation, the subject well's runtime was about 70 per cent per month, with roughly three workovers per year to replace failed pumps. Post-installation, Saponja notes, the well has not been down once, and the pump has not required changing.

"With this system, we have been able to produce the well not only with great runtime, but at a lower bottomhole pressure than could be achieved, pretty much, by any artificial-lift system. We are producing the well generally at around 200 kilopascals at the bottom, which is an extremely low pressure at 2,300-metres vertically deep.

"That has been a huge value-add for the well. You are looking at a $1.2-million addition to net present value on the well as a result of installing that system."

Currently building multiple units, Production Plus manufactures in southeastern Calgary. The company's intent is to take this technology to the U.S. in the fourth quarter of 2015, as the HEAL System appears to be ideally suited for the Eagle Ford, Permian and Bakken.

According to Saponja, the system is effective in medium and light oil, as well as liquids-rich gas scenarios. While Production Plus has yet to apply the technology to heavier oils or SAGD, it should provide higher reliability in those environments as well. The system is also showing promise for gas well de-liquefaction and enhanced frac flowback efficiencies.

Currently, Saponja notes, the system is installed on over 30 horizontals in seven different Canadian reservoir horizons, improving production performance on each well by 10-30 per cent. He adds, "This technology was borne out of an operator who faced many production challenges and recognized limitations with current artificial-lift systems. The mother of invention here was the pain of those challenges." ■