MULTILATERAL LEG RE-ENTRY USING PRESSURE ACTIVATED TOOL WITH COILED TUBING: CASE HISTORIES

John G. Stewart
BJ Services Company

ABSTRACT

Even though drilling multi-laterals is a preferred method to increase production from a single wellhead, re-entering these laterals can be difficult, time consuming, and costly. But without proper treatment, say for example, acidizing the laterals, the well may not produce at its potential.

There are pressure activated tools that can get coiled tubing back into the laterals. With other attached tools to the pressure activated tool, cleaning or acidizing the laterals is possible at reasonable pump rates.

This paper will discuss the theory behind its use, how the tool works, case histories, successes, problems encountered and how to avoid these problems in advance.

BACKGROUND

Generally, the more formation exposed to the well bore the better the well will produce. Multilaterals, fracturing, acidizing, etc. can achieve this goal of exposing more formation. Multilaterals expose much more rock while achieving great permeability. Fracturing or acidizing can accomplish these goals, but may not stay in zone or may get into a water zone. A multilateral takes a more controlled path than fracturing or acidizing takes. Even though reduced rates and pressures can help fracturing and acidzing to stay in zone, multilaterals have some definite advantages. In multilaterals, for example, there can be smart completions, more pipe can be run with controlled reentry guides, but this can be very costly. Stable open hole (OH) completions are cheaper than running smart completions, more casing jewelry, pipe, etc. But with a tool that can re-enter those lateral open or cased holes on the end of coiled tubing (CT), clean outs and/or acidizing can be accomplished. In addition, the acid is selectively placed across the lateral instead of as in bullheading, the majority of treatment is spent on the heel of the lateral.

THEORY AND TOOL OPERATION

The theory of this tool is that at the open hole junction, last hole drilled will be the first hole into which the coiled tubing and bottom hole assembly (BHA) will fall, note: if two or more laterals, each lateral off the main lateral should be the same inside diameter (ID). Basically, when a lateral is drilled, the drilling BHA goes “down and away”. The down part is usually due to gravity, which will assist the coiled tubing BHA to also fall down. Continue going into the hole with CT to the end of the lateral to verify which lateral you are in, by the depth. Before even going in the hole, a simple calculation needs to be made to see if there is enough bottom hole pressure (BHP) to operate the tool, or if back pressure tools need to be added, to help offset the lack of BHP. It is important when drilling the laterals to vary the measure depth (MD) of each lateral by about 100 feet, so that you will have a good reference point and not have any confusion in which lateral you are. Knowing the depth, the tool is pulled back up to below the junction. The tool is then pressured up to a designed pressure and begins to rotate 360 degrees. The pressure should not drop as the tool is designed not to kick over until the calculated larger size ID of junction is encountered. The tool is pulled up in designed increments until the predetermined ID is encountered. The tool will kick to designed 15 degrees, will start leaking, and will show this pressure drop at surface. Please note that the tool can be cycled as few or as many times as necessary, depending on accurate data reported and good depth correlation. Then start running the tool into lateral found, pressure up to straighten tool. Run in hole until next lateral MD, pull up below junction and repeat functioning of tool. This tool was designed to find all laterals first, and not to pump any acid until all have been found. This can deviate, such as making more runs and running secondary tools. As the tool is pulled up the hole acidizing, it will fall into the other hole at the junction, run in hole washing, then pull back up acidizing, repeat at every junction. For example see figure 1. The main lateral “a” was drilled then “b”, “c”, and “d” respectively. For finding and treating the laterals with this pressure type tool, the following sequence would take place. Running in hole (RIH), the BHA would fall into lateral “d”, verify depth, pull up to junction a-d,

function tool, find the main lateral “a”, RIH into lateral “c” verify depth, pull up to a-c junction, function the tool, find main lateral “a”, RIH to end of lateral “b” verify depth, pull up to a-b junction, find rest of main lateral “a”, RIH verify depth. Now that you have located each lateral, you can pull up to +/- 15 feet below a-b junction. Wash down to the end of lateral “a” with water, come up the hole acidizing. Stop pumping acid about 15 ft below the junction, go past junction with water, RIH to junction; the BHA will fall into lateral “b” go past the junction about 15 ft, wash down to the end with water, acidize up to 15 below the lateral, go to water, pull up hole (PUH) to past a-c junction, RIH to junction; tool will fall into “c” lateral, wash to end, acidize PUH to 15 ft below junction, go to water, PUH past a-d junction, RIH to junction; tool will fall into lateral “d” , wash with water to the end, PUH acidizing to 15 ft below junction, go to water up 15 ft past the junction, go to acid for the rest of the main lateral “a”. Please note that this is just one scenario for washing and acidizing.
Additional stages of washing and acidizing can be used to place acid on main lateral in between junctions, or if logs dictate, may want to place more or less acid in different parts of the lateral. The acid stimulation could be an underbalanced wash job or shut in the backside and do a squeeze job. In the scenario above, no acid was pumped across junctions and the water rate was decreased, so as to minimize breaking down the junction. If the junction gets wallowed out, it could make it hard to get back in during future treatments or tool runs. Another scenario could be to incorporate foam stages to act as a diverter placed in areas already acidized. This and many other scenarios have been done as suggested by the Service Company or at request of the customer. Some customers may want higher pump rates for shorter pump times. In this case, other tools can be combined to achieve from 1.3 bpm to 8 bpm.

CASE HISTORIES

This tool has been run successfully in Canada, US, and overseas. Some different type of well bores are depicted in the figures below and are related as follows:

A well in Crane County with wellbore as depicted in Figure 1. The well had originally been drilled vertical and perforated. Later two laterals were drilled and the whipstocks removed to gain production from first set of perforations in the vertical wellbore. The pressure activated tool was run below the lower lateral, since correlation depth was close the tool was functioned only 3 times and the lateral was entered. The lateral was washed underbalanced with water going in and acidized with foamed diverted stages coming out. The tool was pulled up the hole to find the upper lateral. Depth correlation was good. The tool was functioned twice the lateral was found. The lateral was washed and acidized. Prior to treatment the well was producing 8 BOPD and 100 BWPD. Ninety days after treatment the well was producing 116 BOPD, 156 BWPD, and 4 MCFD.

About 12 wells similar to figures 1 and 2 have been treated using the pressure activated tool, in years 2001 through 2004. These were in the following counties, Crane, LaSalle, Andrews, Terry, Yoakum, and Hockley, with five different operators. The depths varied from about 4000’ MD to about 13000’ MD. In most of the wells, the objective was achieved. For example, if 3 legs off the main lateral or one leg off casing was the objective, the tool was very successful in finding and treating the laterals. Some wells were injectors and some were producers. Most of these wells were re-entry. That is, they were originally vertical wells, and then laterals were added later. Unfortunately, there was not any production or injection data on the laterals before treatment to compare to post treatment of the laterals. But, the customers were very pleased with the outcome in either event. To reinforce this attitude, there was one well that had been shut in for a few weeks before the laterals were treated with the pressure activated tool. The well was put on line before treatment, but was making 10 bopd and 25 bwpd, which was much lower than similar wells that had been treated. After treatment there was a decision made to change the pattern and make the well an injector, but since the injection pressure was inline with other injectors that had been treated it was considered a successful treatment A few of the wells had some problems and they are discussed below.

PROBLEMS AND HOW TO AVOID

One problem encountered was there was not enough BHP to operate the pressure activated tool. One back pressure tool was added, but it was discovered during the job that the BHP was lower than had been reported. To avoid this, a quick pressure survey before this job would have been very beneficial.

In another case, the operator had a completion where they had never been able to get into the OH lateral off of the main open hole. While running in hole, the operator said that he thought the lateral was “around a certain depth”. This depth was different than what was originally given. The lateral was still not found, as the operator was not sure

where it was actually located. If the operator understands up front, that if a good reference is not available, it may take several functioning's of the pressure activated tool to find the lateral. Do not give up too soon.

As in another well, the lateral could not be found at the depths given. It was suggested to the customer to try 32' above and 32' below reported depth (32 feet is about the length of a drilling joint). The lateral was found 30' feet high of where it was supposed to be. Here this customer had committed to not give up too soon.

There was a case where "ghost holes" were present, but this information was not given until doing the job. That is, where an unintended short lateral was drilled. The ghost hole was off of the mark intended, so while drilling, they pulled back out and reoriented the tool, and drilled at about the same junction, another hole. This multi lateral junction can make it difficult if not impossible to get into the proper lateral. It is important to have only one lateral per junction, have the junctions well documented, clean of fill or debris, and not damaged. Changing out the length of the tool end (wand), can get you into the right lateral, but the customer chose to not go this avenue. Have this data available up front, so that it can be weighed before starting the job.

Still yet another lateral case, one out of two off the main lateral was not found. This one was drilled very close to the end of the casing in the open hole. Here it was suspected that since the lateral junction was so close to the casing, that the tool did not have enough length in the lateral to orient as needed. So here the solution would be to set the casing a little higher , if possible, or start the lateral junction deeper in the OH.

Overall, you can see that the tool is very successful, given the proper data and a more time if necessary. Other add on tools make it more versatile for different pump rates or job designs. Even though the tool is functioned with a full column of fluid, it can be have N2 pumped through it for foaming up the hole (diverting acid) as desired.

REFERENCES

M. Lambert: "Multilateral Well Leg Re-Entry Made Possible With Unique Coiled Tubing Down Hole Tool", paper, SPE 60702.
Jeff Harris: "Multilateral Leg Re-Entry with Coiled Tubing", paper, 2002 SPSC.

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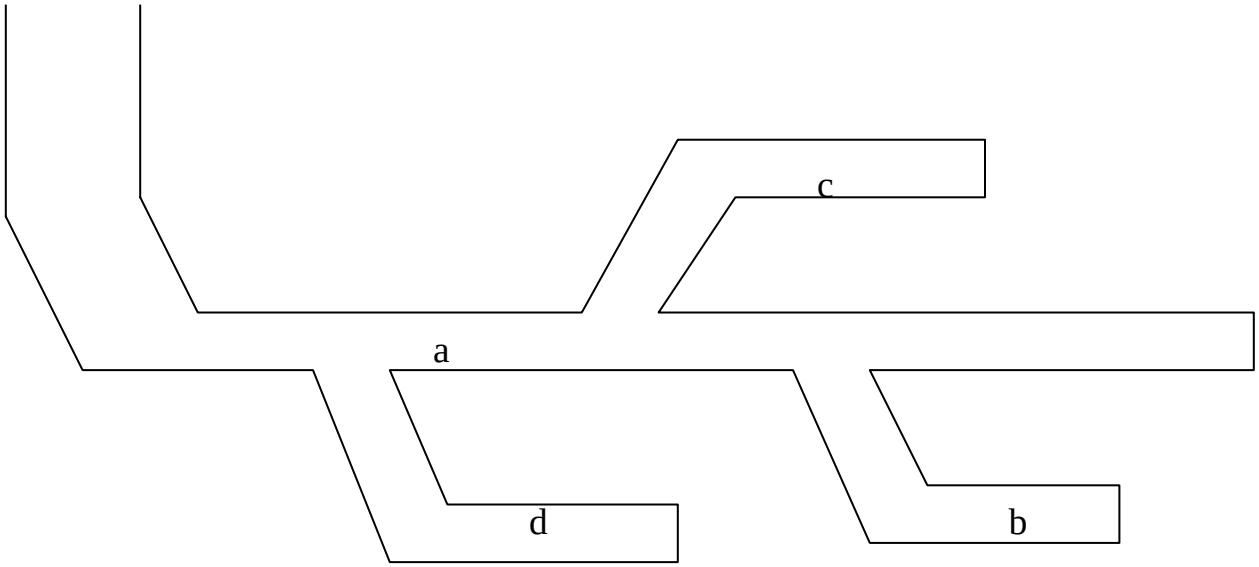

Figure 1

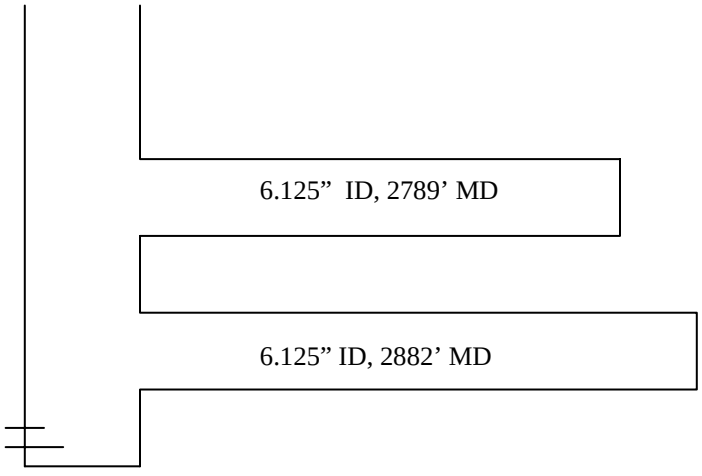

Figure 2