

# FOCUSED PRODUCTION MEASUREMENT SYSTEM

Jay Miller  
Tech-Flo Consulting, LLC

## WHAT IS IT AND WHAT DOES IT DO?

The Focused Production Measurement System is an updated version of an idea that was originally designed, run and tested in 1999. The FPMS is a system that uses a hydraulic jet pump to inflate inflatable packers to isolate stages in a multi-stage well, it produces them to full drawdown and measures the produced fluid as it passes a newly designed and tested production logging tool. The PLT used in this system measures 4 phases of flow; Oil, Gas, Water and Sand. It also measures pressure and temperature. Another feature is it measures the drawdown at each stage to determine the drawdown pressure needed at the stage to move the different phases out of the fractures.

## THE ORIGINAL IDEA

In early 1998 while sitting in Andy Padilla's Chevron office in Midland, Andy asked Miller if he had any idea of how to determine where the water was entering the lateral of his newly drilled open hole horizontal wells. The wells were in the McElroy Field south of Crane, Texas. He told Miller that he had tried swabbing the wells when isolated by straddle packers. This worked, but he did not feel he could make water shut off decisions based on the limited drawdown he could achieve while swabbing the wells. He then tried gas lift with straddle packers. He could achieve the drawdown he desired while using gas lift, but as he moved the packers and gas lift valves up the hole, the gas lift design did not perform like he wanted it to, and he gave up on that method. He then tried an ESP with the packers and again achieved the desired drawdown, but it was cost-prohibitive when he repositioned the pump and packers up in the hole.

At the time, Miller was selling inflatable packers for TAM International and thought that an inflatable straddle system with some form of artificial had to work. Andy asked Miller if he would think about it and get back with him if he had any ideas. Miller took the question back to, Doc Stokley, the Engineering Director at TAM. Stokley and Miller sat down and discussed the issues they might face in a job like this. Some of the issues they thought they might face were as follows;

Would they need a mechanical or an inflatable packer straddle to isolate the interval? *Inflatable Elements were chosen.* What inflatable elements could be set multiple times in an open hole vugular carbonate reservoir? *TAM's External Inflate Elements were chosen*

What artificial lift method could be used to produce the interval at full drawdown could be moved easily? *Hydraulic Jet Pump.* What artificial lift method that when moved would still produce at full drawdown without having to pull out of the hole and reconfigured? *Again, a Hydraulic Jet Pump was picked.* Finally, how would a jet pump and inflatable packers work together? The jet pump and inflatable packers work great together. A jet pump requires high pressure power fluid pumped down the tubing through a venture nozzle to lower bottom hole pressure and produce a well. The process of pumping through the nozzle builds pressure in the tubing. When the jet pump and packers are connected by 1/4" stainless steel tubing, the pressure from the jet pump can be used to inflate the packers and lower the bottom hole pressure of each test interval. This lowered pressure allows the fluid, gas and sand to move out of the fracture and up through the production tubing to the jet pump. The produced fluid and the injected power fluid are pumped out the side of the jet pump into the casing above a packer to be produced to the surface.

## THE SOLUTION

The Solution in 1998 was a 3-packer isolation system. It was run on jointed pipe. One inflatable packer and a jet pump were run in the vertical section of the well just above the kick off point. A set of inflatable

packers in a straddle configuration 100' apart was run so that it could be run to TD in the lateral. The 3-packer system produced the fluid pumped from in-between the packers to be produced to the surface where it could be separated and measured.

A successful job was run for Chevron in 1999. A paper was written for the SWPSC and presented in the spring of 1999. The paper is named "Locating and Controlling Water in Horizontal Wells in the Perelman Basin." Miller separated from TAM shortly after the paper was presented. Without his focus on selling the system, it was only run a few times after the initial run.

### THE RESURRECTION

In 2015 Miller joined Tech-Flo Consulting, an Artificial Lift Company specializing in Jet Pumps. At that time, he was reminded of the Chevron job and he began to focus on a modification and a resurrection of the system that was run for Chevron. He had spent his years since leaving TAM working in the wireline business where he was introduced to Production Logging. Production logging by itself is not an accurate method to evaluate modern multi-stage wells. While Production Logging is accepted science by the Oil and Gas industry, many Engineers don't completely believe the Production Logging results in multi stage comingled wells. Miller redesigned the system run in 1999, simplifying it and adding direct production measurement.

### FEATURES OF THE NEW SYSTEM

Two packers rather than three. When deploying the 3- packer system, you are required to run 1/4" stainless steel tubing to connect the top packer to the straddle. This distance can be a few thousand feet. It was expensive and hard to run. Using 2 packers allows you to run a very short piece of stainless steel tubing to connect the jet pump to the packers. This simplifies the bottom hole assembly, but you can no longer produce the fluid to the surface to be measured. To measure the fluid, a newly designed and tested Production Logging tool was placed into the bottom hole assembly below the jet pump. The produced fluid travels from the straddled interval through pipe and up to the jet pump. With the tool affixed to the bottom of the pump, the fluid is measured as it passes the logging tool. The tool measures Oil, Gas, Water & Sand. The Drawdown is measured directly across from the interval being straddled. The Phases are measured by sensors designed to measure each phase. The flow is measured by an array of 8 Doppler sensors rather than spinners. Step rate testing is performed to determine the drawdown needed to move different phases out of the fractures. Tests can be performed in real-time or memory mode. In memory mode, the tool can measure for 7 days. Conveyance methods include; Coiled Tubing, Fiber or E-line enabled coil Tubing and Jointed Pipe.

### FIELD TRIAL

An oil and gas well operator wanted to test 6 vertical zones for 3 phase production and producing formation pressures. The 4 phase sensors were not operational when the field trial was run. The Refrac Roadmap™ or Focused Production Measurement system was selected and for the test.

### FIELD TRIAL RESULTS

After testing the 6 zones for 3 hours apiece, the system was removed from the well bore and the data was downloaded from the PLT and analyzed. The results indicated that two of the zones were producing 100% water and a third zone was producing majority water and minimal hydrocarbons that were not marketable. The jet pump drew the formation pressure down to and below 100 psi at pump intake resulting in absolute zone production potential.

### REMEDY

Upon completion of the analysis of the PLT data, Tech-Flo and the Operator decided to set a bridge plug above the 3 non-hydrocarbon producing zones and isolate the majority of the water production from the well. The operator then chose a jet pump from Tech-Flo to produce the 3 productive zones for permanent production. Water production decreased from the well by 140 bpd while oil production stayed constant at 65bpd with minimal water. By controlling the water production from the well the operator saved \$ 25,000.00 USD per month in disposal and water hauling expenses.