Abstract

Gas interference in downhole oilfield pumps is an old and well-known problem. Horizontal wellbore topology and construction exasperates this problem.

Artificially lifting an oil and gas well involves *two* discrete state-variable spaces: the pumping system and backside multiphase flow. While positive strides have been made around optimizing the pumping system state-space, optimization of *that* system cannot optimally control the latter since they are defined by different, discrete state-spaces.

My patented, field-tested closed loop control system tackles the "second" state system and adds stability to an otherwise unstable open loop system.

A system prototype was tested on a horizontal Bakken well during the summer of 2021. The well parameters included a total vertical depth of approximately 10,000' and a measured depth of 20,000'. The well was rod lifted and included a Weatherford pump off controller as well as a VFD. The well had a GOR of typically less than 1,000 scf/bbl oil.

The prototype field-trial of the control system produced the following results:

- Significant improvement of pump fillage evidenced by POC computation. Prior to system integration the pump fillage was typically 50% (this value was transient in nature, related to changing backside flow regimes). The well was producing 20+/- bopd at the time of installation, with production slipping, see Figure 1.
- After full integration of cloud access via local cell VPN router, the pump fillage improved to 100%, and the daily production significantly improved, see Figure 1. Intuitively an increase in production was expected since the control system's main function is to increase pump volumetric efficiency.

The significance of understanding, modeling and controlling the state-space system defined by transient backside flow regimes near the down hole pump, and the contribution of this specific technology in controlling same should be further tested. I am seeking an operating partner that would be interested in a larger-scale, multi-well study to allow further research and development of the control system.

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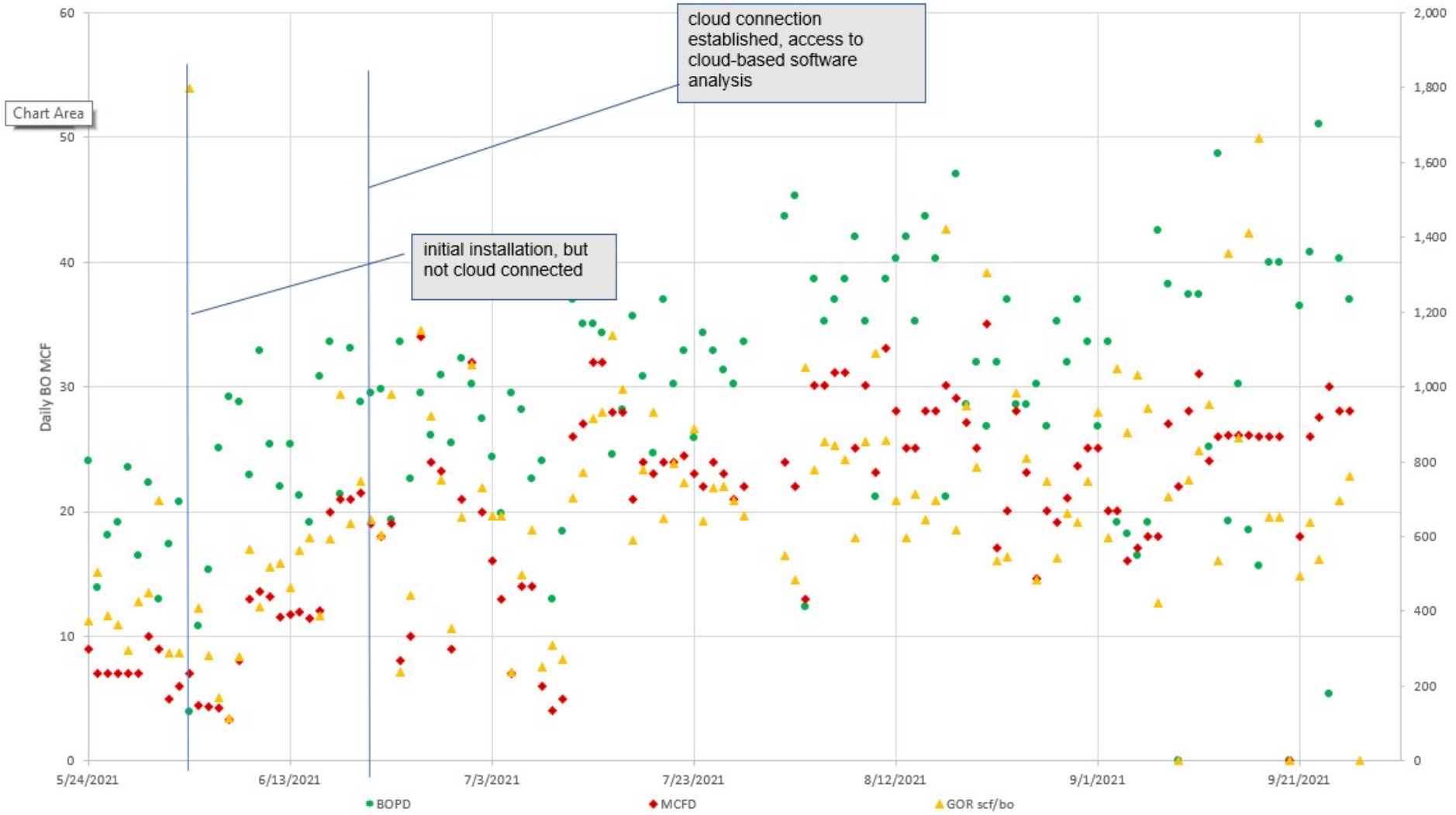
cloud connection established, access to cloud-based software analysis
initial installation, but not cloud connected
Chart Area
Daily BO MCF
60
50
40
30
20
10
0
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5/24/2021
6/13/2021
7/3/2021
7/23/2021
8/12/2021
9/1/2021
9/21/2021
BOPD
MCFD
GOR scf/bo

Figure 1