



MPD Solution: Fracking Pressure Intrusion While Drilling

Managed Pressure Drilling techniques provide several different drilling solutions for oil and gas drilling operations. Apart from completing drilling operations with tight margins, MPD application is also used in completing drilling plans on wells that are over pressured from hydraulic fracturing. Hydraulic fracturing is a well stimulation technique in which rock is fractured by a pressurized liquid. The process involves the high-pressure injection of 'fracking fluid' (primarily water, containing sand or other proppants suspended with the aid of thickening agents) into a wellbore to create cracks in the deep-rock formations through which natural gas, petroleum, and brine will flow more freely.

Introduction

Hydraulic fracturing operations involve relatively large volumes of fluids being pumped into a producing formation at pressures greater than the formation's fracture pressure to create a fracture network. Since the formations have extremely low permeabilities, the primary fracture network that is created during hydraulic fracturing operations is designed to extend radially up to several hundred (150-300) feet.

Challenge/Problem

Drilling in shale formations require multiple wells on the same pad that will be drilled and fractured. As a result, operators need to properly plan their well fracturing operations to control pressure and fluid movement within the target geologic formation so that these changes do not adversely interact with nearby or offset wells. Unfortunately, due to the close proximity of these wells, frac fluid occasionally migrates and interferes with ongoing drilling operations. Challenges range from: (a) severe pressure build up and kicks, (b) fluid migration into ongoing drilling operation contaminating the drilling fluids, (c) inducing differential sticking, (d) highly pressured faulted and fractured formations, and (e) formation instability.

Pruitt MPD has successfully planned, executed, and completed multiple wells where a high pressure influx has occurred as a result of nearby fracking operations impacting the drilling operation. In the US land nonconventional (shales and tight sands) formations, it is common for several operators to develop acreage via drilling multiple wells on pads in close proximity to other well pads. When drilling on a pad is completed, the fracking operations may commence. Communication between wells being fractured and nearby drilling has resulted in high pressure being transmitted to the nearby drilling operations, resulting in well control events and associated delays, interruptions, and possible abandonment.

Action/Solution

The solution to hydraulic fracturing communication is the application of Pruitt MPD to the ongoing wells. Two separate drilling operations in the Niobrara shale were successfully completed with Pruitt MPD by the application of anchor point pressure to high pressure fracture zones preventing the fracture fluids from migrating and contaminating the current drilling operation. The pressure was contained without altering the original mud weight being used to drill the well.

Execution/Results

Pruitt successfully executed both drilling operations by applying pressure to the well when needed to contain the fracture fluid, as shown in the hydraulic simulation below. The wells were both completed and casing cemented within the projected plan period. Due to the temporal nature of the migrating fluid, the back pressure was released once the communication stopped in one well while the second well was slowly killed by allowing the migrating fluid, in a controlled nature, into the tanks and stored for further use by the operator.

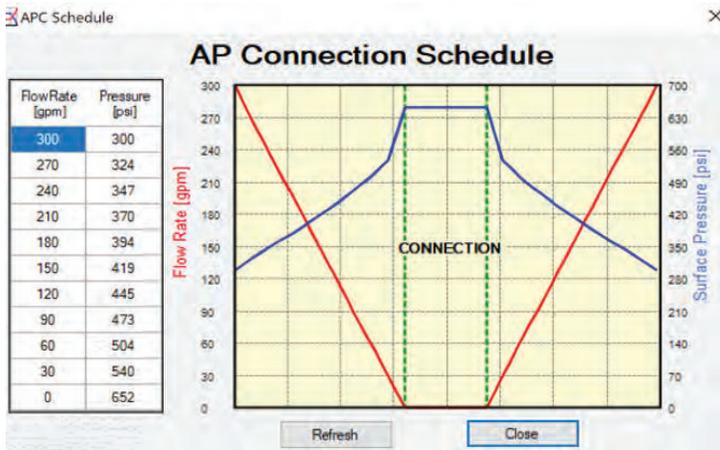


MPD Solution: Fracking Pressure Intrusion While Drilling

In both operations, MPD crews applied between 50-300 psi surface pressure and 400-850 psi surface back pressure during connections to mitigate the frac fluid migrations.

Details

During the first drilling operation, fracture fluid migrated into the well being drilled and increased the bottom hole ECD from an 11.7 ppg ECD to a 13.0 ppg ECD at 12797 Ft. MD. MPD applied corresponding surface back pressure to mitigate the pressure, at the same time controlling the rate of drilling fluid contamination to only 50 bbls per day. This process allowed the mud engineers to adjust the mud in the well, while also maintaining the required yield point mud. The well was drilled from 12797 Ft. MD to 18119 Ft. MD, with MPD application of back pressure ranging from 50 psi to 300 psi while drilling and 400 psi to 700 psi during connections. As the well was approaching the planned total depth to be drilled, the hydraulic fracturing was already completed in the nearby fracking project and the communication stopped. The corresponding surface back pressure was released, as the fracking pressure bled down; the well was



then cased and cemented conventionally.

On the second well that was controlled and completed by MPD, the well was planned and drilled to total depth with similar drilling parameters as the first well without communication issues. While the rig was POOH, they observed gaining in the trip tank; a flow was performed, and the well was found to be flowing rapidly. The rig confirmed a fracturing operation was in progress at a nearby well. MPD immediately closed the choke while the rig stripped out, with pressures ranging between 400 – 850 psi. At 7000Ft MD a 14 ppg heavy pill was pumped to kill the well. Casing was run to bottom without displacement and circulated through MPD. A cement FIT test was successfully performed to 900 psi, and then casing was cemented through MPD.

