

OPERATOR CHALLENGE:

A South Texas operator was faced with completing a challenging **Vicksburg** well in **Starr County, Texas** (Figure 1). While drilling, hole conditions forced the operator to switch mud systems mid-operation and to forgo running open hole logs. Cased hole logs were acquired, but were inconclusive. Two target intervals (10,500’ and 10,100’) were selected for commercial evaluation. Each sand interval showed similar results from both the mud logs and the cased hole logs. The operator was left wondering if these two intervals would prove to be commercial intervals, and **if they should be fracture stimulated**.

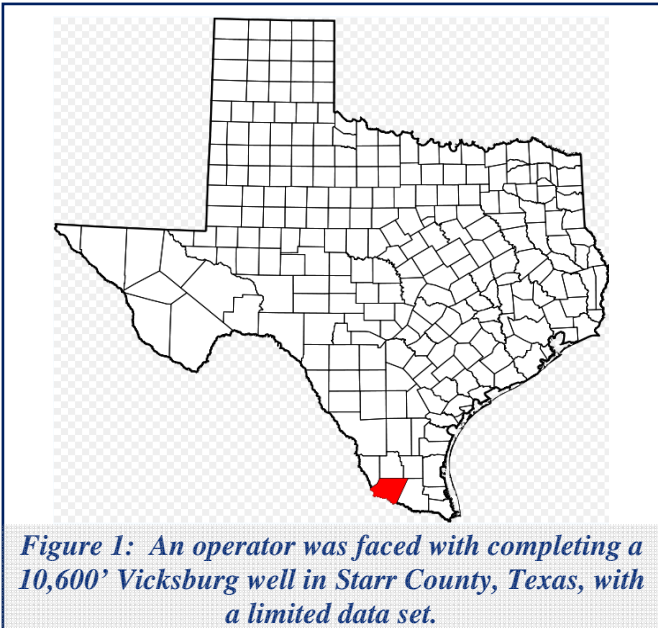


Figure 1: An operator was faced with completing a 10,600’ Vicksburg well in Starr County, Texas, with a limited data set.

NUTECH SOLUTION:

The operator was familiar with **NuTech Energy Alliance’s NuFIT™ (NuTech Fracture Injection Test) process** and elected to use it as a guide for completion of this limited data well. Similar injections were designed and pumped in both of the intervals in place of the breakdown (Figure 2). After each break down, surface pressure data was recorded for a 24 hour shut-in period. This extended shut-in is necessary in order to obtain enough data to properly evaluate the reservoir properties. The NuFIT was easily integrated into the completion procedure for these intervals, and added **minimal cost** as the operator was planning to break down these intervals prior to fracturing regardless.

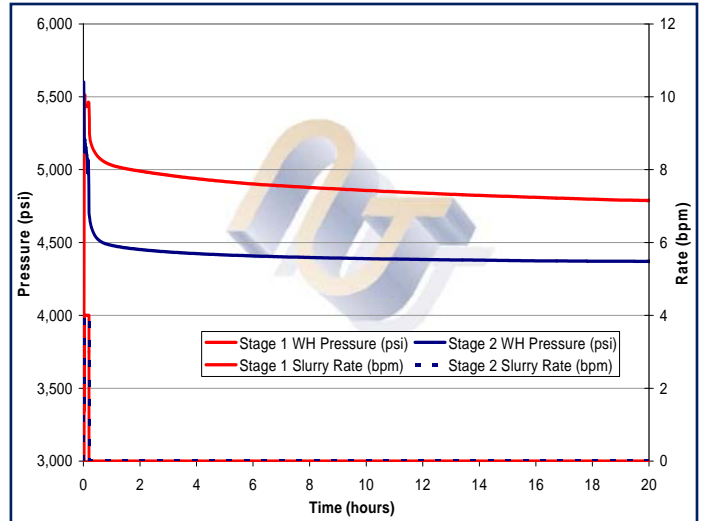


Figure 2: Similar break downs/tests were designed and executed in both Vicksburg intervals and monitored with surface gauges.

NuFIT is an analysis oriented product in which NuTech engineers aid in the development of an injection test procedure in order to collect specific data on the interval. This data is then analyzed to obtain direct measurements of the formation properties. These measurements include **formation closure** and **pore pressure** along with the average **permeability**. NuFIT is used to aid in the calibration of the NuStim™ process as a means to alter the treatment prior to hydraulic fracturing.

THE RESULTS:

Both intervals were perforated and broken down with 40 bbls of 2% KCl treated water. Shut-in pressures were monitored for 24 hours with a surface memory gauge after each break down (Figure 2).

Interval Test #1

From the test of the first interval (10,500’), the fracture gradient was determined to be 0.936 psi/ft, with 342 psi leak-off observed in the initial two hours of shut-in. This is representative of the information typically obtained from a break down or pre-frac FET. The injection and shut-in pressure data was sent to NuTech for analysis and the well was allowed to flow back up the casing. The interval flowed approximately 50 bbls of load water with some gas before dying.

The NuFIT analysis identified a G-time closure of 22.6 for this interval, and measured a closure pressure of 9,346 psi, pore pressure of 9,240 psi, and an average permeability of 0.001 md for the 25 foot interval (Figure 3). **These results are indicative of a tight zone which would not be recommended for completion.**

Despite the poor flowback results and the NuFIT analysis, the operator and partners **elected to stimulate the interval** with a massive hydraulic fracturing operation. Approximately 200,000 lbs. of proppant was pumped into the zone, after which the well was allowed to clean up and the interval was tested and **deemed non-commercial**. The 10,500' interval was then plugged back as the operator moved uphole to the second Vicksburg interval of interest.

Interval Test #2

The second interval (10,100') was tested with the same procedure as the first interval. From the test, the fracture gradient was determined to be 0.9 psi/ft, with 290 psi leak-off observed in the initial two hours of shut-in. Based on this information alone, typical of the results of break down or pre-frac FET, the interval would be expected to be similar to or worse than the 10,500' interval. The injection and shut-in pressure data was **sent to NuTech for analysis** and the well was allowed to flow back up the casing. Like the 10,500' interval, the well flowed back some of the load water with some gas before dying.

Due to fact that this **interval had similar mud log shows and cased hole log responses** to the first interval, and **even less initial leak-off**, the operator planned to plug this interval, avoiding the costly stimulation treatment, prior to reviewing the NuFIT results.

The NuFIT analysis, however, identified a G-time closure of 1.41 for this interval, a measured pore pressure of 8,709 psi, and an average permeability of 0.175 md for the 40 foot interval (Figure 3). NuTech informed the operator of these results prior to them sending the AFE to plug the zone to their partners. Based on past successes with the NuFIT technique, the operator knew the **validity of the technology** and elected to fracture stimulate the interval.

After stimulation, the second stage Vicksburg interval IP'd at 860 MCFPD and 483 BWPD, flowing at 3,400

| | | Vicksburg | |
|---|---------------------------------|---|-------------------------------------|
| | | Stage 1 | Stage 2 |
| Standard FET or Breakdown Results (based upon 2 hr shut-in) | ISIP (psi): | 5326 | 4738 |
| | Frac Gradient (psi/ft): | 0.936 | 0.901 |
| | Initial Leak-off (2 hrs) (psi): | 342 | 290 |
| | Flow Back Results: | ~50 Bbls water with some gas, then died | Load water with some gas, then died |
| NuFIT Parameters | Reservoir Pressure (psi): | 9240 | 8709 |
| | Permeability Feet (md-ft): | 0.025 | 6.984 |
| | Ave Perm (md): | 0.001 | 0.175 |
| | G-Time Closure: | 22.6 | 1.41 |
| Results: | Frac'd, Non-commercial, plugged | Frac'd, Commercial, IP'd @ 860 MCF/D | |

Figure 3: Comparison of NuFIT analysis results for both Vicksburg intervals.

psi up the 4.5" casing. Eighteen days after the frac, the interval was flowing approximately 350 MCFPD, 15 BOPD, and 150 BWPD, **making a commercial well.**

CONCLUSIONS:

The NuFIT provided a means to **accurately characterize these intervals** when other tests would have fallen short. An FET would have been misleading since both zones had similar 2-hour leak-off responses. A pre-frac build-up was not an option since the intervals would not flow prior to stimulation.

The operator was able to **successfully complete a Vicksburg interval with limited data based on the NuFIT analysis** (Figure 3). The operator now believes the mud system change caused damage to the interval which masked its potential prior to fracturing. Since NuFIT measured formation parameters after a fracture was created, **any formation skin was removed from the analysis**, making the interpretation of the **true formation characteristics** straightforward.

For more information about how NuFIT can aid in your decision making process, contact your local NuTECH representative.