



November 30, 2016

Mr. Jacob Thomas
Completions Engineer II
SandRidge Energy
123 Robert S Kerr Ave,
Oklahoma City, Oklahoma 73102

**Re: Injection Pressure Request
Judy 1-30 (API# 05-057-06466)
Jackson County, Colorado**

Dear Mr. Thomas,

The Step Rate Test (“SRT”) report is attached and the data indicates a fracture gradient of 0.74 psi/ft. The table below shows the estimated operating conditions for the well as completed with 2-7/8” injection tubing.

Rate (bpm)	Rate (bpd)	Calculated BH Pressure (psig)	BH Pressure Gradient (psi/ft)	Calculated Pipe Friction ¹ (psi)	Surface Injection Pressure (psig)
0.5	720	4,500	0.58	54	1,050
1	1,440	4,730	0.61	74	1,300
2	2,880	5,100	0.66	58	1,654
3	4,320	5,550	0.72	191	2,237
3.7	5,328	5,750	0.74	366	2,612 ²
5	7,200	6,000	0.77	490	2,986
8.4	12,096	6,700	0.86	1,335	4,531

¹Calculated pipe friction for normal operations based on 7,712 ft of 2-7/8” Tubing.

²Requested injection pressure based on estimated fracture gradient and calculated pipe friction. Rate not used during test.

IPT appreciates the opportunity to work with you and SandRidge on this project. Please do not hesitate to call if you have any questions or require any additional assistance.

Sincerely,

Joel Mazza
Production and Reservoir Advisor

Neal Hageman, P.E
Engineering Manager



1.0 Executive Summary

IPT analyzed and evaluated the step rate test (SRT conducted on the completion on the Lakota and Dakota formations in the Judy 1-30 well). This analysis was performed to determine the fracture propagation pressure. The results of the analysis are shown in Table 1.

The step rate test was conducted through the perforations at 7,730 ft - 7,776 ft and 7,830 ft – 7,902 ft MD/TVD and was performed by starting injection at 0.5 bpm and stepping up to a final rate of 8.4 bpm down the 2-7/8” tubing into the perforated 7” casing. Surface tubing pressure was monitored with the service company pumping equipment. Tubing friction pressures were calculated at each injection rate to determine the bottom hole pressure based on the recorded surface treating pressure (Table 1).

The following are the general conclusions and observations of these evaluations:

- The step rate test indicates the fracture propagation for the injection formations occurred at ~5,750 psi (0.74 psi/ft) at a rate of 3.7 bpm (5,328 bpd). Accounting for friction effects at 3.7 bpm in 2-7/8” tubing, this extrapolated bottom-hole pressure should be realized at a surface injection pressure of 2,612 psi (Table 1).

Table 1: Injection rates and pressures during test.

Rate (bpm)	Rate (bpd)	Measured Surface Pressure ¹ (psig)	Calculated BH Pressure (psig)	BH Pressure Gradient (psi/ft)	Calculated Pipe Friction ² (psi)	Hydrostatic Pressure ³ (psig)	Surface Injection Pressure (psig)
0.5	720	1,050	4,500	0.58	54	3,504	1,050
1	1,440	1,300	4,730	0.61	74	3,504	1,300
2	2,880	1,654	5,100	0.66	58	3,504	1,654
3	4,320	2,237	5,550	0.72	191	3,504	2,237
3.7	5,328	N/A	5,750	0.74	366	3,504	2,612 ⁴
5	7,200	2,986	6,000	0.77	490	3,504	2,986
8.4	12,096	4,531	6,700	0.86	1,335	3,504	4,531

¹ Step rate test pumped down 2-7/8” Tubing.

² Calculated pipe friction for normal operations based on 2-7/8” Tubing.

³ Brine water used during the step rate test (8.58 ppg).

⁴ Requested injection pressure based on estimated fracture gradient and calculated pipe friction. Rate not use during test.



2.0 Review of step rate test

The step rate test in the Judy 1-30 was performed on November 8, 2016. Rates of 0.5, 1.0, 2.0, 3.0, 5.0, and 8.4 bpm were utilized during the test. A total of 1,374 bbls of 1.03 SG brine water was pumped during the test.

The following figures are used in the analysis:

Figure 1: SRT time chart.

Figure 2: SRT rate chart.

Observations from the step rate test (SRT) evaluation are shown below:

- The change in the bottom-hole pressure trend with increasing rate (Figure 2) at ~3.7 bpm (extrapolated) indicates that the fracture propagation pressure is approximately 5,750 psi at the bottom of the 2-7/8" tubing. This corresponds to a fracture propagation gradient of 0.74 psi/ft.

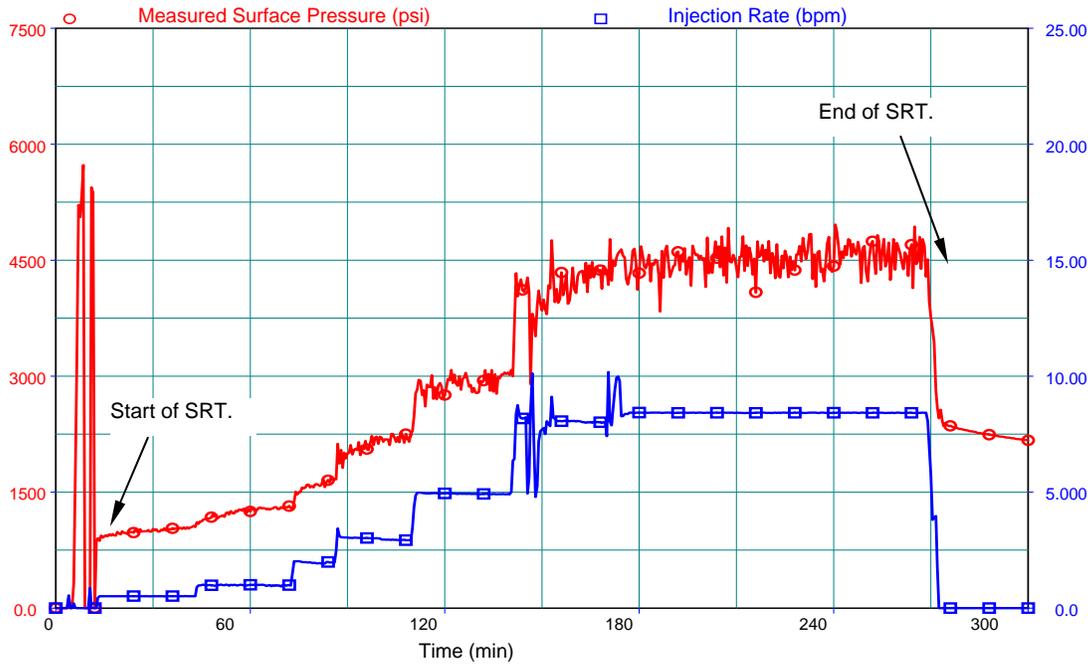


Figure 1: SRT time chart.

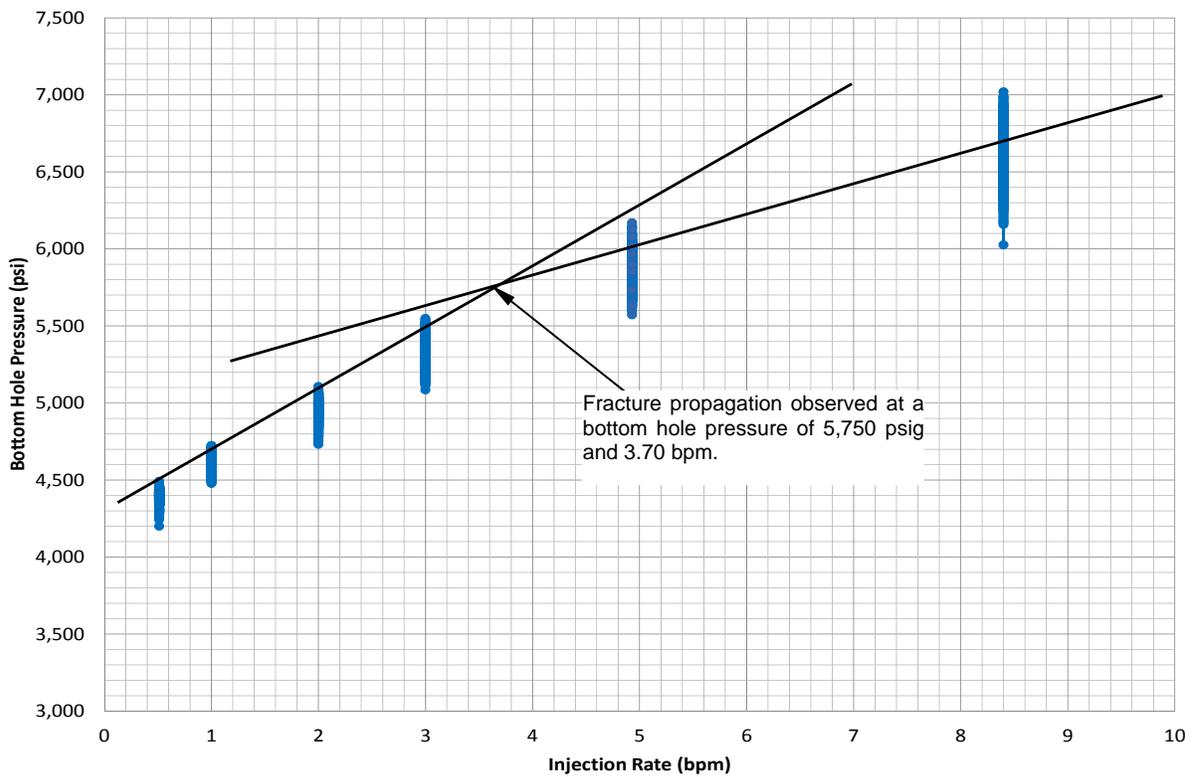


Figure 2: SRT rate chart.