

Adam Johnson

From: Bob Koehler - DNR <bob.koehler@state.co.us>
Sent: Tuesday, April 03, 2018 10:10 AM
To: Adam Johnson
Subject: RE: Frac Gradient determination - Greasewood
Attachments: Foundation_State36-6_Form 5A #1884139_05-19-2008.pdf

Adam,

I talked to Stuart just now. We get slightly different numbers but in principle we agree that you can use the CO2 Frac Data from the State #36-6 (API: 123-26639) to support the maximum surface injection pressure for the Behring 23-7 (API: 123-21830) well. The State #36-6 is about 2.1 miles SSE of the Behring 23-7.

Here is how we are calculating things.

Breakover pressure from your charts was 2075 psi.

Our Form 5A – Completed Interval Report # 1884139 5/19/2008 says 5-1/2" production casing was set down to 6592 ft, drilled out, and the D-Sand open hole fractured.

We use 6592 ft as the perforation depth.

Head for freshwater is 0.433 psi/ft

Pump rate at break was about 15.75 bpm from your chart.

5-1/2" Casing at 15.75 bpm gives a Friction Pressure of 3.1 psi/100 ft (from a chart)

3.1 psi/100 ft = 0.031 psi/ft.

Friction Pressure through 5-1/2" casing at 6592 ft = 6592 ft x 0.031 psi/ft = 204.3 psi

Surface Injection Pressure + Head at Top Perf – Friction = Bottomhole pressure

2075 psi + (6592 ft x 0.433 psi/ft) – 204.3 psi = 4725.0 psi Bottomhole pressure

4725.0 psi/6592 ft = 0.7168 psi/ft Fracture Gradient (Foundation says 0.75 psi/ft, no friction correction)

Maximum Surface Injection Pressure Calculation:

MSIP = (Frac Gradient – Head) x Perf Depth x 90 % safety factor

MSIP = (0.7168 psi/ft – 0.433 psi/ft) x 6592 ft x 0.9 = 1684 psi.

Foundation's Maximum Surface Injection Pressure at the Behring 23-7 would be 1684 psi.

If you agree to 1684 psi, please rewrite what's above on your own letterhead and send it in with the State 36-6 charts as attachments to the Behring 23-7 Subsequent Form 31.

Feel free to contact me with questions. (I've got staff from 9:30 to 10:30 today.)

Sincerely,

Robert P. (Bob) Koehler, PhD.
UIC Lead – Geology Advisor

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Email: Bob.Koehler@state.co.us



From: Adam Johnson <ajohnson@foundationenergy.com>

Sent: Monday, April 2, 2018 4:23 PM

To: Bob Koehler - DNR <bob.koehler@state.co.us>

Subject: Frac Gradient determination - Greasewood

Hey Bob,

For determining the frac gradient of the proposed injector in Greasewood Unit...

I figured out where the .75 psi/ft gradient came from. The nearest offset I was able to find a frac report on was the State 36-6. See attached.

You can see the breakdown pressure on the surface is 2,075 psi. If you assume a .433 hydrostatic gradient (top perf = 6,604'), that make bottom hole pressure = 4,926 psi at the time of fracture creation. That corresponds to a .75 psi/ft gradient.

They were pumping down 5-1/2" casing with friction reducer, so I reason friction is negligible.

Please let me know if you have any questions. If you accept the .75 psi/ft gradient, then we will forego the step rate test and plan to just MIT the well later this week.

Thanks,

Adam Johnson | Operations Engineer

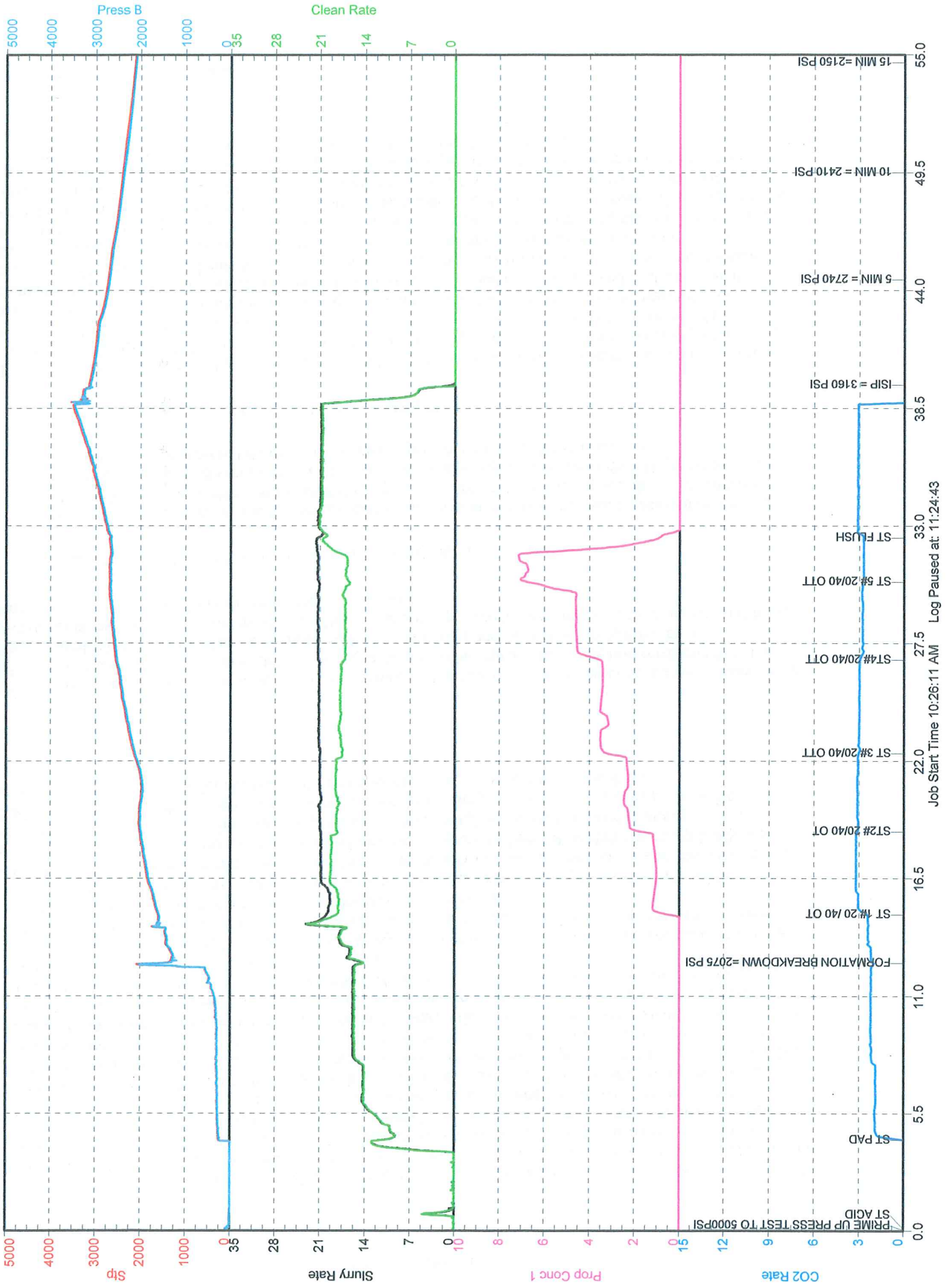
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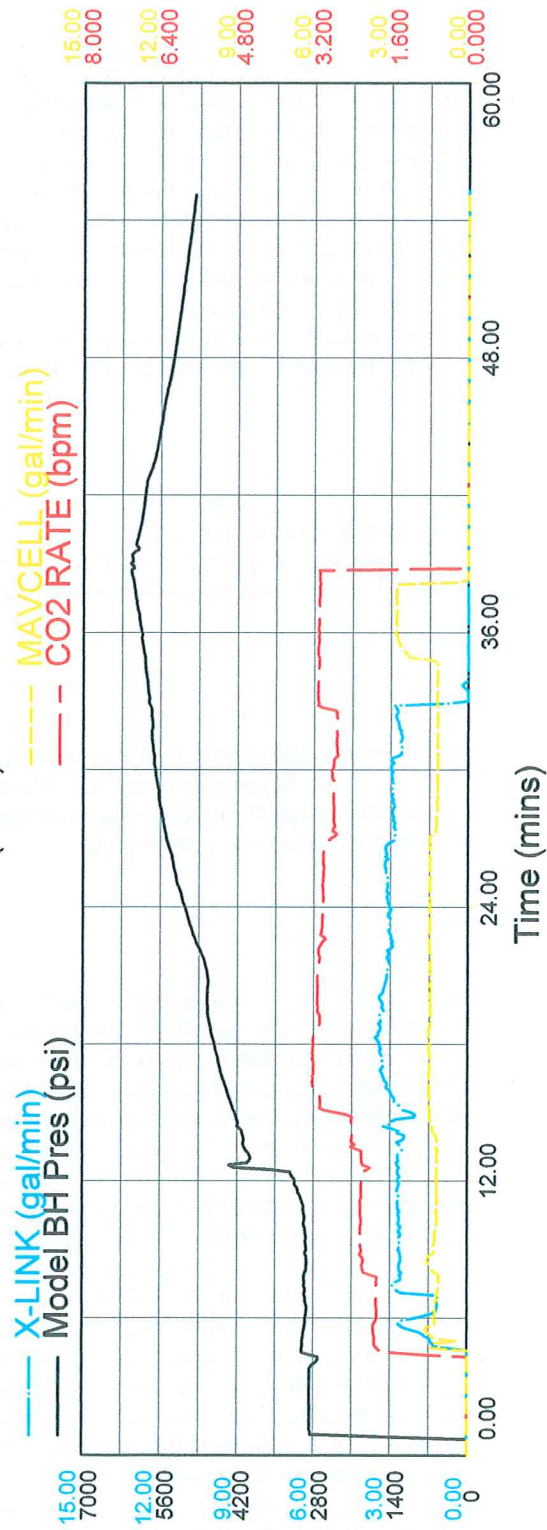
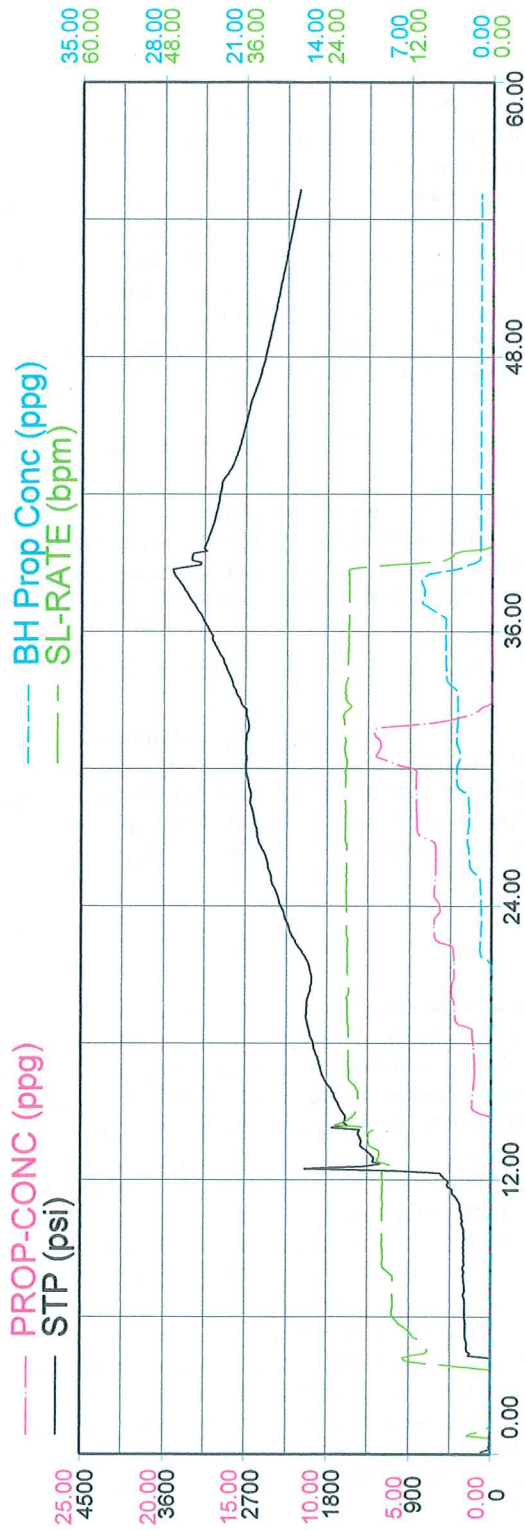


DIVERSIFIED OPERATING
STATE #36-S - D-SAND - COMMINGLED CO2 FRAC





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SEC. 36 - 6N - 61W

03/17/08 WELD Co., CO