*Notes on EGS Collab Experiment 1 flow data*

Stimulations of EGS Collab Experiment 1 testbed started in May 2018 and completed in December 2018. Three pre-notched intervals at nominal depths of 128 ft, 142 ft, and 164 ft were stimulated in the injection well (E1-I), each multiple times. This data submission includes all flow data, namely injection rate, pressure, and other time-history data measured by the flow and stimulation system, for all the stimulation activities at EGS Collab Experiment 1. The stimulation tests, data, and results are covered in more detail by Burghardt et al. (2020). The only stimulation and flow data from 2018 that are not included are those from the one-month circulation test from late October to November 2018, as this submission is focused on stimulation rather than circulation testing. The stimulation and flow data from circulation tests are covered in a separate submission.

Each CSV file has several dozen channels. The intended use of these channels is described in the accompanying spreadsheet named “aaaaaa.xlsx”. Note that many of these channels were not active during these tests. The channels that measured injection rate and injection pressure changed from tests to tests, mostly depending on which pump was used. File “Stimulation\_Rate\_and\_Pressure\_Channels.txt” lists all the CSV files in the submission and the ID of the injection rate and injection pressure channels.

# Brief description of the stimulation and flow activities covered by this data submission.

May 21, 2018:

First day of stimulation at 142 ft interval.

May 22, 2018 (142 ft notch):

Continued to stimulate the 142 ft interval to create a fracture with a nominal radius of 1.5 m. As the pressure was significantly higher than the pre-measured Shmin value, the team suspected that the injection was into a natural fracture instead of breaking down the rock from the notch. Decided to move to a deeper notch at 164 ft.

Note: The two stimulations at 142 ft notch had been collectively referred to as “stimulation 1” by the team in certain documents. The subsequent stimulations at the 164 ft notch (May 22 to May 25) had been called “stimulation 2”. This nomenclature is discouraged to avoid confusion, especially because the 142 ft notch was stimulated again in December 2018. Any specific stimulation “episode” should be referred to by date and depth.

Note: The fracture systems that were subjected to the two relatively long circulation tests, from Oct. 2018 to Nov. 2018 and from Feb. 2019 to Feb. 2020, respectively, were stimulated from the 164 ft interval, most significantly between May 22 and May 25, 2018.

May 22, 2018 (164 ft notch):

The intention was to initiate a hydraulic fracture from the target notch and propagate the fracture to a nominal radius of 1.5 m according to calculations and simulations in the design phase.

May 23, 2018:

Gradually stepped up the pressure and injection rate to propagate the fracture to a nominal radius of 5.0 m.

May 24, 2018:

Used high injection rates to further propagate the fracture to connect to well E1-P. Significant flow was observed out of wells E1-OT and E1-P 10 and 11 minutes, respectively, after the injection was switched to flow rate-control (aka constant rate control), indicating a fracture(s) intersecting these two wells. The injection rate under flow rate-control (aka constant rate control) was initially at 2.6 L/min and increased to 5 L/min when the intersections took place.

May 25, 2018:

Two episodes of stimulation.

The first of the two episodes on 25 May, was performed to repeat the injection of stimulation 524 (5/24) to make additional SIMFIP measurements in two wellbores, E1-I and E1-P.

In the second episode, a downhole camera was used to survey well E1-P to enable visual observations of fracture intersections with the well. The downhole camera data and analyses are available at (<https://gdr.openei.org/submissions/1227>).

June 14, 2018:

Pressure transient tests in E1-I and E1-P, respectively.

June 20, 2018:

E1-I step pressure test (Day1).

June 21, 2018:

E1-I step pressure test (Day2). Increased E1-P pressure while maintaining E1-I at 3700 psi but no significant flow between the two wells. Later increased injection rate in E1-I in steps and a modest amount of outflow, particularly from E1-OT was observed.

June 22, 2018:

E1-I step pressure test (Day3). Injected into E1-I to see outflow from other wells. Fairly high rate was used near the end of the day.

June 25, 2018:

Two stimulations, 625P and 625I, were conducted to interrogate behaviors of the testbed. For stimulation 625P, two relatively short injections were attempted in well E1-P. The packer interval, through which the fluid entered the formation, was between 39.34 m (129.07 ft) and 40.59 m (132.86 ft) deep, the interval that was earlier identified to contain a hydraulic fracture intersection. Approximately 60% of the injected fluid flowed back as the well was vented soon after the injection.

For stimulation 625I, the injection interval still covered the 50 m deep notch. Higher injection rate and larger injection volume were used in an attempt to enhance the connectivity between E1-I and E1-P. The flow rate out of E1-P reached 400 ml/min or approximately 10% of the injection rate, while the flow rate out of E1-OT reached 200 ml/min. A different pump (Haskel) than the one used in other stimulation episodes was used for stimulation 625I, resulting in high-frequency fluctuations in both the injection rate and injection pressure .

July 11 to 12, 2018:

Intermediate flow rate experiment. The goal was to perform injection at 400 ml/min (lower and higher rate were tested before) for a relatively long duration to test the system capacitance. It was thought that the response of E1-P to E1-I injection is affected by such capacitance. The injection packer was reinstalled without SIMFIP due to damage. It might have been installed at a slightly different depth than in earlier stimulations. After adjusting the packer, a long injection (11 hours) was performed on July 12. There was fluid leaking out at E1-P collar so the packer in E1-P was moved multiple times to capture the flow. Both E1-P and E1-OT saw significant flow but it is difficult to correlate the change in such flow with injection activities.

July 18 to 20, 2018:

Stimulating shallower notch at 128 ft. A short injection was performed on July 18; observed apparent break-down (relatively subtle, similar to previous stimulations) behavior. July 19 has four hours of injection including step pressure tests. Packers were moved several times to block significant leakage in E1-1 but leak persisted. July 20 had long and a large quantity of injection, including a high rate with triplex pump. E1-I leak was minor after the last packer relocation but increased with injection rate and quantification. No fluid observed from E1-P throughout the day but leak through OT was observed toward the end of the day.

December 7, 2018:

Re-stimulation of the 142 ft interval. Had to terminate the test due to damage to one of the injection packers.

December 20 to 21, 2018:

Re-stimulation of the 142 ft interval. One short and two long stimulations. Started with one packer placed right next to the notch to increase stress concentration. MEQ data indicate that a hydraulic fracture might have been created in this configuration. The team had to relocate the packer to block leaking from a natural fracture. The subsequent stimulations are believed to have stimulated a different system.