

Class VI Injection Well Application

Attachment 07: Injection Well Plugging Plan
40 CFR 146.92(b)

Aster Project
Madison County, Indiana

24 July 2024

Project Information

Project Name: Aster

Project Operator: Vault GSL CCS Holdings LP

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Aster Project Injection Well 1 (AST INJ1) Location:
Madison County, Indiana
Latitude: 40.30026° N
Longitude: -85.65565° W

Table of Contents

1. Planned Tests or Measures to Determine Bottomhole Reservoir Pressure.....	5
2. Planned External Mechanical Integrity Test(s)	5
3. Information on Plugs	6
4. Narrative Description of Plugging Procedures	8
4.1. Notifications, Permits, and Inspections	8
4.2. Plugging Procedures	8
5. References	13

List of Figures

Figure 1: PBI AST INJ1 plugging schematic.	11
Figure 2: PBI AST INJ1 with intermediate contingency plugging schematic.....	12

List of Tables

Table 1: Potential mechanical integrity tests to be run in AST INJ1.....	5
Table 2: PBI Plugging details for AST INJ1	7

List of Acronyms

AST INJ1	Aster Project Injection Well 1
BOP	blow out preventer
CO ₂	carbon dioxide
EPA	Environmental Protection Agency
LD	lay down
MIT	mechanical integrity test
ND	nipple down
P&A	plugging and abandonment
POOH	pull out of hole
PU	pick up
QASP	Quality Assurance and Surveillance Plan
RIH	run in hole
RU	rig up
TD	total depth

Vault GSL CCS Holdings LP will conduct the injection well (AST INJ1) plugging and abandonment (P&A) according to the following procedures at a time that is deemed appropriate during the post-injection site care (PISC) phase of the project.

1. Planned Tests or Measures to Determine Bottomhole Reservoir Pressure

As required by 40 CFR 146.92(b)(1), prior to any plugging operations, bottomhole pressure data from the bottomhole gauges set in AST INJ1 will be used to determine the injection zone pressure and calculate an appropriate kill fluid weight. Should the gauges be inoperative, the bottomhole pressure will be obtained by conducting a static gradient survey using a memory pressure gauge run on slickline.

2. Planned External Mechanical Integrity Test(s)

Vault GSL CCS Holdings LP will conduct at least one of the tests listed in Table 1 to verify external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(a). Table 1 should not be considered as a comprehensive or final list for this project.

Table 1: Potential mechanical integrity tests to be run in AST INJ1.

Test Description	Location
Temperature log	Along wellbore via wireline well log
Radioactive tracer log	Along wellbore via wireline well log
Cement bond log	Wireline well log
Pulsed neutron log	Along wellbore via wireline well log

Prior to any field mobilization or operations, proper notification will be given to the Environmental Protection Agency (EPA). The specific logs and/or tests to be run to determine external mechanical integrity will be provided as part of the notification.

Note the following:

1. Example procedures for the logging techniques provided above can be found in Attachment 06: Testing and Monitoring (2024).
2. Specifications on the tools that will be used for this testing can be found in Attachment 10: Quality Assurance and Surveillance Plan (2024).
3. Criteria for acceptable logging results can be found in Attachment 06: Testing and Monitoring (2024) and Attachment 10: Quality Assurance and Surveillance Plan (2024).

3. Information on Plugs

Vault GSL CCS Holdings LP will use the materials and methods noted in Table 2 to plug the injection well. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The cement(s) formulated for plugging will be compatible with the carbon dioxide (CO₂) stream as outlined in (Attachment 01: Narrative, 2024). The cement formulation and required certification documents will be submitted to the EPA with the well plugging plan. The owner or operator will report the wet density and will retain duplicate samples of the cement used for each plug.

The general plugging methodology is as follows:

- Approximately 500-foot plugs to be used throughout the well,
- CO₂-resistant cement will be used from total depth (TD) to approximately 500 feet above the Eau Claire Shale,
- Class A cement to be used from 500 feet above the top of the Eau Claire Shale to surface.

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4. Narrative Description of Plugging Procedures

4.1. Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), Vault GSL CCS Holdings LP will notify the regulatory agency at least 60 days before plugging the AST INJ1 well and provide updated information, if applicable.

4.2. Plugging Procedures

In compliance with 40 CFR 146.92, the following will be done:

1. The regulatory agency will be notified at least 60 days before any field activity begins with an updated plugging plan.
2. Move in the workover rig and rig up on AST INJ1.
3. CO₂ pipelines will be marked and noted with the rig supervisor and facility manager.
4. Hold safety meetings with all available rig crew, contractors, and facility personnel.
5. Based on the calculated kill fluid weight needed from the bottomhole pressure survey, kill the well.
 - a. It is anticipated that approximately 9.5 pounds per gallon will be appropriate. This weight is subject to change based on the result of the bottomhole pressure survey. It is noted that regardless of the results of the pressure survey, 9.5 pounds per gallon will be the minimum fluid weight.
6. Ensure that rig pump or another suitable pump is rigged up to the well. Pressure test all lines to minimum 2,500 psi. Perform annulus pressure test.
7. Fill tubing and cased hole volume with kill brine. Monitor tubing pressure to ensure the well is dead.
8. Once the well is dead, nipple down (ND) the well head.
9. Nipple up and test blow out preventers (BOPs).
10. Latch onto and remove tubing hanger from wellhead.
11. Lay down (LD) tubing hanger.
12. Latch onto tubing.
13. Unlatch from packer
 - a. Note that, at this time, the well is likely to u-tube. Ensure rig pump is connected to the top side, close the BOPs, and slowly circulate out the annulus fluid while maintaining a full column of fluid (as feasible).
14. Pull out of hole (POOH) with tubing and LD same.
 - a. Fill hole as necessary.
15. Pick up work string with packer pulling tool and run in hole (RIH).
16. Latch onto packer and remove same.
17. POOH with work string and packer. LD same.

18. RIH with open end work string.
19. Tag bottom. Note tag depth.
20. Run in with and set cement retainer within 20 feet of the top of the long string float collar.
21. If not run on work string, RIH with work string and tag top of retainer, note tag depth.
22. Pressure test retainer seal to 1,500 psi.
23. Sting into cement retainer and pump plug #1 as follows:
 - a. Pump 50% excess over the calculated hole volume
 - b. When retainer pressure up to 1,000 psi, hold pressure for 10 minutes to ensure cement retainer sealing elements hold.
 - c. Sting out of cement retainer and dump minimum of 25 feet of cement above the retainer.
 - d. Pressure test to 1,000 psi to ensure retainer and cement plug hold.
24. Target top of plug #1 should be [REDACTED] feet. Trip work string out to approximately 100 feet above the anticipated cement top. Wait at that depth for approximately two hours.
 - a. Wait time is dependent on hardening time for cement.
 - b. Wet samples of cement should be taken.
25. RIH and tag top of cement. Note top of cement. Ensure cement top has not moved.
26. Pump plug #2
 - a. Pump 10 feet off bottom.
 - b. Target height of plug should be 500 feet. Plug volume should be as detailed in Table 2.
 - c. Slowly pull out of hole if necessary while pumping plug.
27. Repeat steps 25 through 27 plugs 3 and 4.
 - a. Note that cement used in these plugs will be CO₂ resistant.
 - b. Target top of plug four to be [REDACTED] feet. This depth is approximately [REDACTED] feet above the top of the Eau Claire Shale.
28. Flush wellbore with brine.
29. RIH with work string and tag top of cement. Note top of cement.
30. Pump plug # 5.
 - a. 10 feet off bottom.
 - b. Target height of plug should be 500 feet. Plug volume should be as detailed in Table 2. Plug to be pumped as balance plug.
 - c. Slowly pull out of hole as necessary while pumping plug.
31. Trip out work string to 100 feet above projected top with cement. Wait two hours.
 - a. Wait time is dependent on hardening time for cement.
 - b. Wet samples of cement should be taken.
32. RIH and tag top of cement. Note top of cement.
33. Pump remaining plugs by repeating steps 24 through 27.
34. Ensure cement is to surface. Fill from surface if necessary.

35. ND BOPs.
36. Rig down rig. All casing should be cut to a minimum of three feet below ground level and have a plate with well information welded on top.
37. Fill and level the ground as necessary.

Note that the procedure presented above assumes that no contingencies are necessary. Cement volumes, pumping pressures, and weights are subject to change based on geologic and field conditions. This plan will be updated following the drilling and completion of AST INJ1.

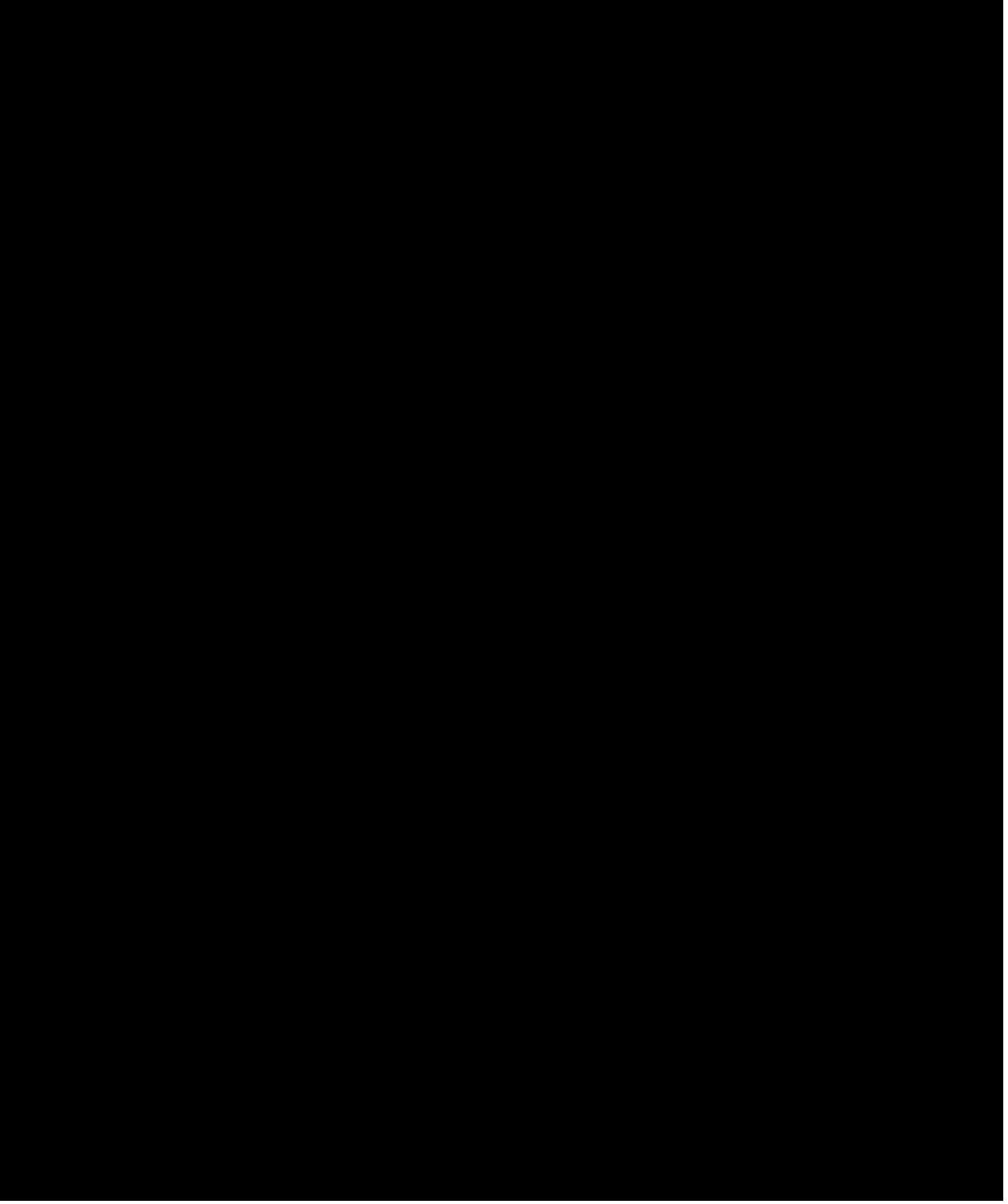
All materials and equipment to be used in this procedure are to be CO₂-resistant to 500 feet above the top of the Eau Claire Shale.

Any contingency plans that are necessary will be provided for as part of the formal procedure submitted 60 days before any field activities.

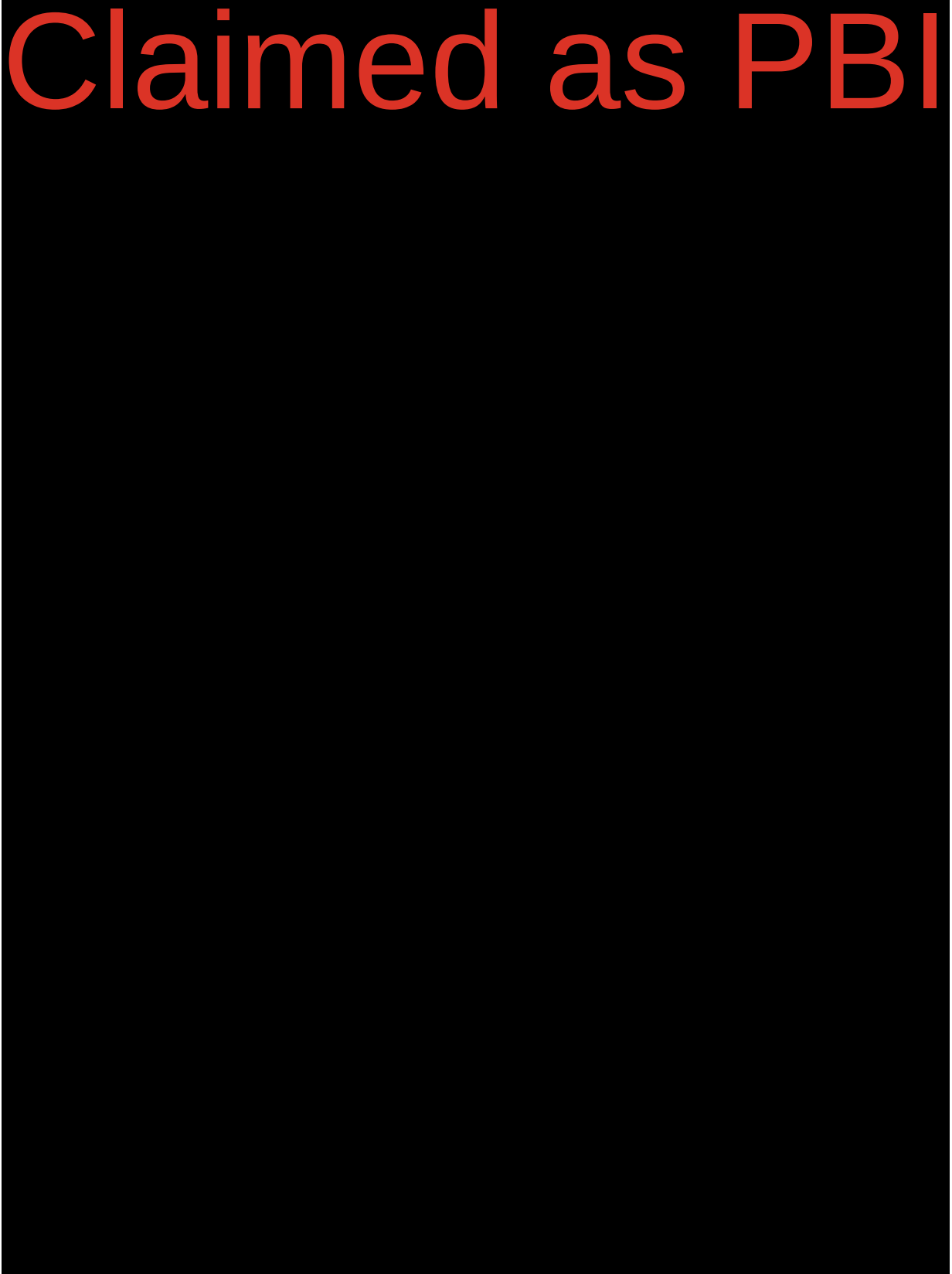
Following the completion of field activities, a report detailing the procedures and processes followed to plug this well will be submitted to the agency. This report will be submitted within 60 days of the completion of plugging.

Figure 1 displays the theoretical plugging schematic for AST INJ1. Figure 2 displays the theoretical plugging schematic for AST INJ1 should the contingency intermediate casing be needed during well installation.

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5. References

Attachment 01: Narrative, 2024, Underground Injection Control Class VI Permit Application: Aster Project.

Attachment 02: AoR and Corrective Action Plan, 2024, Underground Injection Control Class VI Permit Application: Aster Project.

Attachment 06: Testing and Monitoring, 2024, Underground Injection Control Class VI Permit Application: Aster Project.

Attachment 08: Post-injection Site Care and Site Closure, 2024, Underground Injection Control Class VI Permit Application: Aster Project.

Attachment 10: Quality Assurance and Surveillance Plan, 2024, Underground Injection Control Class VI Permit Application: Aster Project.