9.0 POST-INJECTION SITE CARE AND SITE CLOSURE PLAN
40 CFR 146.93

CAPIO MOUNTAINEER SEQUESTRATION PROJECT

Facility Information

Facility name: MOUNTAINEER GIGASYSTEM

Facility contact: Michael Neese
Vice President, Operations and Project Development
[redacted]

Well name: MCCLINTIC SEQUESTRATION 001

Well location: MASON COUNTY, WEST VIRGINIA
Latitude: [redacted]
Longitude:

Table of Contents

List of Tables

List of Figures

9.0 Post-Injection Site Care and Site Closure (PISC) Plan

9.1 Introduction

This Post-Injection Site Care and Site Closure (PISC) plan describes the activities that Fidelis, LLC ("Fidelis") will perform to meet the requirements of 40 CFR 146.93. Fidelis will monitor groundwater quality and track the position of the carbon dioxide (CO_2) plume and pressure front for 50 years after the cessation of injection.

9.2 Pre- and Post-Injection Pressure Differential (40 CFR 146.93(a)(2))

Pressure front modeling within the area of review (AoR) at the MCCLINTIC SEQUESTRATION 001 injection well at the highest pressure point in the system is expected to rapidly decrease to pre-injection levels after cessation of injection. [redacted] Additional information on the projected post-injection pressure declines and differentials is presented in the AoR and Corrective Action Plan (Permit Section 2.0).

Figure 9-1 shows the modeling results of pressure behavior during the injection phase of the project and a 50-year post-injection period for the gridblock containing the topmost injection well perforation within the computational model which is used to delineate the AoR for the project. Refer to the AoR and Corrective Action Plan (Permit Section 2.0) for more information on the delineation of the AoR.

Figure 9-1: Pressure time-series data during the 10 year injection period followed by 50 year post-injection at the gridblock of the topmost perforation

9.3 Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure (40 CFR 146.93(a)(2))

Figure 9-2 shows a map view of the predicted maximum extent of the pressure front which is modelled to occur 10 years after the end of injection (green outline) and the maximum extent of the CO_2 plume (after the 50-year post-injection period).

Figure 9-2: Outlines of the CO_2 saturation plume at end of 50-year PISC (black outline), and maximum threshold pressure which occurs 10 years after the end of injection (green).

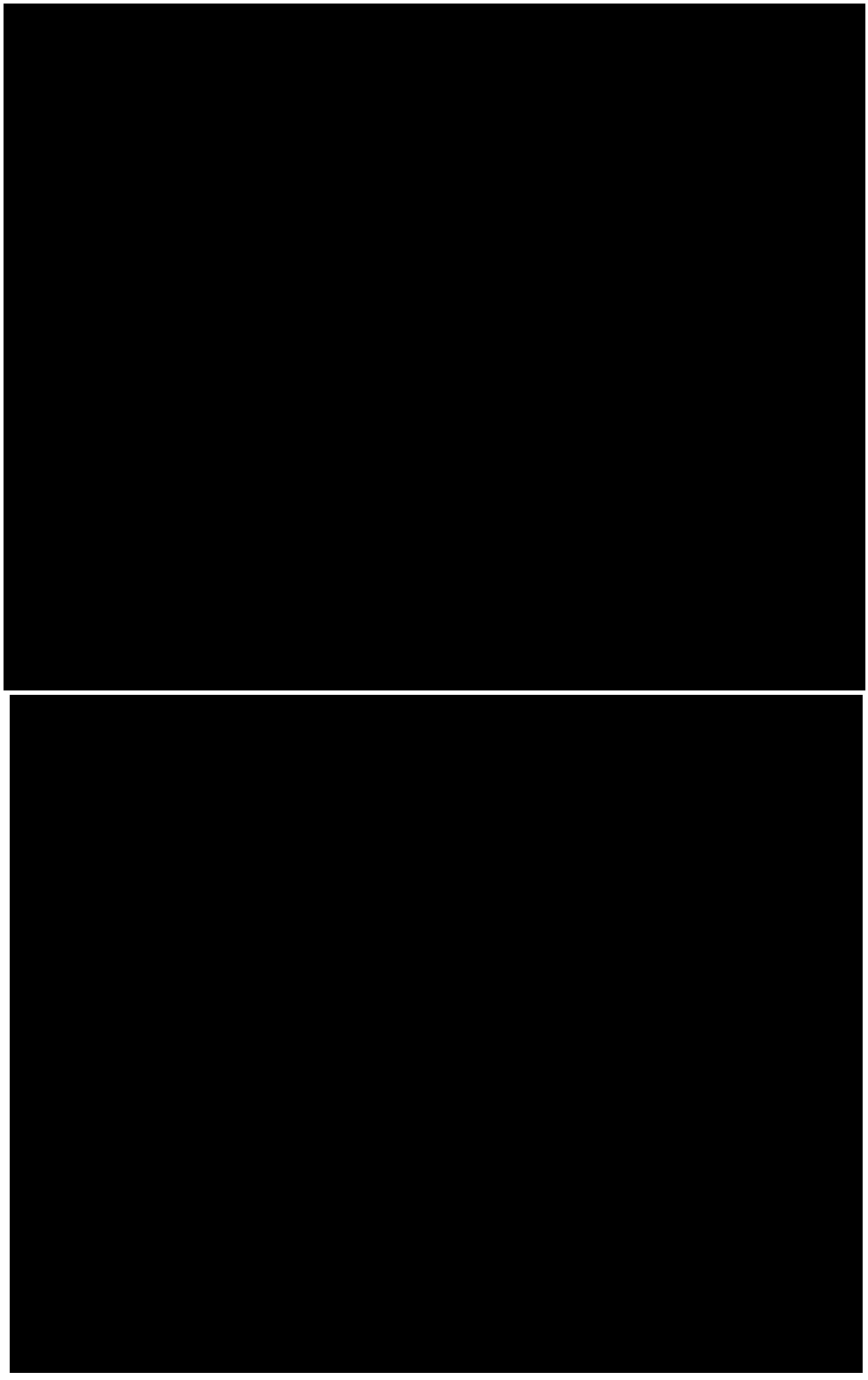

Figure 9-3: Cross-sectional view of pressure buildup (pressure in excess of initial pressure), at end of injection (top) and 5-years after end of injection (bottom,). Excess pressures above the threshold have completely dissipated 5-years after end of injection.

9.4 Post-Injection Monitoring Plan (40 CFR 146.93(b)(1))

Performing groundwater monitoring, storage zone pressure monitoring, and geophysical monitoring as described in the following sections during the post-injection phase will meet the requirements of 40 CFR 146.93(b)(1). The results of all post-injection monitoring will be submitted semi-annually in the first year after injection and annually in subsequent years.

A quality assurance and surveillance plan (QASP) for all testing and monitoring activities during the injection and post-injection phases is provided in Appendix 7.A of the Testing and Monitoring Plan (Permit Section 7.0).

Table 9-1 summarizes the initial monitoring activities that will take place during the PISC phase of the project. If it can be demonstrated based on these monitoring results that the potential for endangerment of USDWs has substantially decreased over time then (in consultation with the UIC Program Director) the frequency of monitoring during the PISC phase will be reduced.

The project team will continue to monitor the well integrity of the injection and deep monitoring well on a yearly basis initially using temperature measurements to ensure that there is no migration of CO_2 up the wellbores. In addition, the tubing annular pressure and fluid volume in the injection well and deep monitoring well will be monitored on a continuous basis until the well is plugged and abandoned. Refer to the Well Operations Plan and the Testing and Monitoring Plan for more information on the well integrity and operational monitoring plans (Permit Sections 6.0 and 7.0, respectively).

Pulsed neutron capture (PNC) logging will initially continue in the deep monitoring well and the above confining zone (ACZ) monitoring well each year of the PISC phase. This will allow the project to continue to characterize the vertical plume dispersion and verify that CO_2 is not migrating past the confining zone and into aquifers above the confining zone, thereby endangering underground sources of drinking water (USDWs). Refer to the Testing and Monitoring Plan for more information on the PNC logging plans in the injection phase of the project (Permit Section 7.0).

The project team will continue to monitor pressures within the storage formation in the deep monitoring well until it is plugged and abandoned. The pressure within the storage formation is expected to begin to rapidly dissipate once CO_2 injection ceases, based on the computational modelling. The storage formation pressure measurements are expected to verify the pressure decrease, and the data will be used to history match the computational modelling in the PISC phase.

Monitoring Activity	PISC Frequency	Location	Depth Range (ft, MD)
Assurance Monitoring:			
Shallow groundwater sampling	Annually	AoR groundwater well network	Producing zone
Verification Monitoring:			
Fluid sampling			
Deepest USDW	Annually	Either ACZ well or independent deep groundwater well	TBD
Pressure Sensors			
Deepest USDW Top confining zone Storage formation	Continuous	Either ACZ well or independent deep groundwater well ACZ well Deep monitor well	TBD TBD TBD
Temperature Sensors (DTS)			
Deepest USDW Top confining zone Storage formation	Continuous	ACZ well ACZ well Deep monitor well	TBD TBD TBD
PNC Logging	Annually	ACZ well Deep monitor well	TBD TBD
Microseismic monitoring	Continuous	Surface stations	TBD
Time-lapse borehole seismic VSP data	Initially every 5 years	Surface	

Table 9-1: Summary of initial monitoring activities in the PISC phase of the project.

9.4.1 Monitoring Above the Confining Zone

The monitoring plan for the PISC is designed to be adaptive and respond to evolving project risks over time. No changes will be made to the PISC without informing the Underground Injection Control (UIC) Director (40 CFR 146.93 (a)(3)).

Table 9-2 presents the proposed initial USDW monitoring program during the PISC phase in the ACZ well and groundwater well network. For fluid sampling, a bailer system or similar method that maintains the formation pressure of the sample will be used to collect water samples to be analyzed for dissolved inorganic carbon, alkalinity, pH, and isotopic parameters. Samples for all other analytes will be collected with an open-ended bailer. Prior to sample collection the well will be swabbed to remove stagnant water and ensure representative water is collected from the formation. The fluid swabbed from the well will be monitored for field parameters, such as pH, specific conductance, and temperature, using a calibrated water quality meter (Horiba U-53, or

similar). Once these parameters stabilize, it will be an indication that representative formation fluid is in the well at the time the sample is collected.

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
Shallow Groundwater	Groundwater geochemistry and stable isotopes	AoR groundwater well network	TBD	Annually
Deepest USDW	Groundwater geochemistry and stable isotopes	Either ACZ well or independent deep groundwater well	TBD	Annually

Table 9-2: Monitoring of ground water quality and geochemical changes above the confining zone in the PISC phase of the project.

Geochemical parameters to be monitored and the analytical methods that will be used are described in Section 7.5.2 of the Testing and Monitoring Plan (Permit Section 7.0). Pressure and temperature data will continue to be recorded above the confining layer in both the ACZ and deep monitoring wells.

9.4.2 CO_2 Plume and Pressure Front Tracking (40 CFR 146.93(a)(2)(iii))

Fidelis will employ direct and indirect methods to track the extent of the CO_2 plume and the presence or absence of elevated pressure during the PISC phase (**Table 9-3**).

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	PISC Frequency
Direct Plume Monitoring				
Storage formation	Pulsed Neutron Logging	Deep monitor well	TBD	Annually
Indirect Plume Monitoring				
Storage formation	Time-lapse borehole seismic VSP data	Surface	AoR	Initially every 5 years

Table 9-3: Initial post-injection phase CO_2 plume monitoring.

Table 9-4 presents the initial direct and indirect methods that will be used to monitor the pressure front. Pressure sensors will be placed on the outside of the casing of the deep monitoring well to allow continuous pressure measurements within the first permeable layer above the confining layer. The sensors will be real-time surface readout sensors connected and

recorded through the Supervisory Control and Data Acquisition (SCADA) system. The sensors will be programmed to measure and record pressure and temperature every minute and rolled up to a daily average for storage. The pressure data will be stored as time-stamped data pairs that can be used for history matching in the computational model.

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
Direct Pressure-Front Monitoring				
Storage formation	Pressure monitoring	Deep monitoring well	TBD	Continuous
Indirect Pressure-Front Monitoring				
Deepest USDW, top confining zone and injection zone	Microseismic monitoring	Surface stations	AoR	Continuous

Table 9-4: Initial post-injection phase pressure-front monitoring.

The results of the geochemical and isotope analysis, PNC logging, and time-lapse three-dimensional (3D) borehole seismic Vertical Seismic Profile (VSP) data will all be integrated to develop a comprehensive understanding of the CO_2 plume development over time. [redacted]

9.4.3 Schedule for Submitting Post-Injection Monitoring Results (40 CFR 146.93(a)(2)(iv))

All PISC monitoring data and results collected using the methods described above will be submitted in reports to the Environmental Protection Agency (EPA) annually. The reports will contain information and data generated during the reporting period (i.e., well-based monitoring data, sample analysis, and the results from updated site models).

9.5 Non-Endangerment Demonstration Criteria

Prior to the end of the post-injection phase, Fidelis will submit a demonstration of non-endangerment of USDWs to the UIC Director, per 40 CFR 146.93(b)(2) and (3). This report will make a demonstration of USDW non-endangerment based on the evaluation of the site monitoring data used in conjunction with the project's computational model. The report will detail how the non-endangerment demonstration evaluation uses site-specific conditions to confirm and demonstrate non-endangerment. The report will include all relevant monitoring data and interpretations upon which the non-endangerment demonstration is based, model

documentation and all supporting data, and any other information necessary for the UIC Director to review the analysis. The report will include the following sections:

9.5.1 Introduction and Overview

A summary of relevant background information will be provided, including the operational history of the injection project, the date of the non-endangerment demonstration relative to the post-injection period outlined in this PISC and Site Closure Plan, and a general overview of how monitoring and modeling results will be used together to support a demonstration of USDW non-endangerment.

9.5.2 Summary of Existing Monitoring Data

A summary of all previous monitoring data collected at the site, pursuant to the Testing and Monitoring Plan (Permit Section 7.0) and this PISC and Site Closure Plan, including data collected during the injection and post-injection phases of the project, will be submitted to help demonstrate non-endangerment. Data submittals will be in a format acceptable to the UIC Director [40 CFR 146.91(e)], and will include a narrative explanation of monitoring activities, including the dates of all monitoring events, changes to the monitoring program over time, and an explanation of all monitoring infrastructure that has existed at the site. Data will be compared with baseline data collected during site characterization [40 CFR 146.82(a)(6) and 146.87(d)(3)].

9.5.3 Summary of Computational Modeling History

The results of computational modeling used for AoR delineation will be compared to the monitoring data collected during the injection and PISC phases of the project. The monitoring data used to update and calibrate the computational modeling and to demonstrate non-endangerment of USDWs will include:

- Pressure monitoring data from the storage formation, above the confining zone, and the deepest USDW
- Microseismic data
- PNC logs that characterize CO_2 saturations and vertical plume development along the well bores
- Time-lapse 3D borehole seismic data

Data generated during the PISC period will be used to help show that the computational model accurately represents the storage site and can be used as a proxy to determine both the CO_2 and pressure plume's properties and sizes. Fidelis will demonstrate this degree of accuracy by comparing the monitoring data obtained during the PISC period against the model's predicted properties such as plume location, rate of movement, and pressure decay. The validation of the computational model with the large volume of available data will be a significant element to

support the non-endangerment demonstration.

9.5.4 Evaluation of Reservoir Pressure

During the PISC phase, the computational modeling predicts that the pressure in the storage formation will steadily decrease toward the pre-injection static pressure. One of the primary forces driving CO_2 or brine migration out of the storage formation is a pressure increase in the storage formation. **Figure 9-1** illustrates the rapid decrease in pressure back to pre-injection levels in the storage formation once the injection phase of the project ends; pressure decline toward pre-injection levels is one factor indicative of USDW non-endangerment.

The project will monitor pressure in the storage formation in the injection well with downhole pressure sensors. The measured pressure will be compared to the pressure predicted by the computational model at the same depth. Agreement between the actual and the predicted values will help validate the accuracy of the model and further demonstrate non-endangerment.

9.5.5 Evaluation of CO_2 Plume

During the injection and PISC phases of the project, the extent of the CO_2 plume will be evaluated by PNC logging and time-lapse 3D borehole seismic VSP surveys.

PNC logging will be used to monitor the distribution and saturation of CO_2 adjacent to the wellbore in the deep monitoring well. The PNC logging results can be compared against the model's predicted plume vertical extent at a specific point location at a specified time interval. A good correlation between the two data sets will help provide strong evidence in validating the model's ability to model the CO_2 plume. Time-lapse 3D borehole seismic VSP data will be acquired at longer time intervals to track the development of the CO_2 plume over a larger spatial extent. Both data types will be used to verify the computational model's ability to predict the CO_2 behavior in the PISC phase of the project and support a demonstration of non-endangerment of USDWs at the end of the project.

9.5.6 Evaluation of Emergencies or Other Events

Mobilized brine from the storage formation may also pose a risk to USDWs. The geochemical data collected from the ACZ well will be used to demonstrate that the storage formation fluids have not migrated above the confining formation during the injection or PISC phases of the project. If these fluids have not migrated beyond the confining zone during the injection or PISC phases of the project, then they are not anticipated to pose a risk to USDWs after the PISC phase. To demonstrate non-endangerment, results of the fluid sampling in the deepest USDW from the injection and PISC phases will be compared to the pre-injection baseline samples. This comparison will support a demonstration that no significant changes in the fluid properties of the overlying formations have occurred and that storage formation fluids have not moved through

the confining layer, and therefore the CO_2 and/or brine would not represent an endangerment to any USDWs.

9.6 Site Closure Plan

Fidelis will conduct site closure activities to meet the requirements of 40 CFR 146.93(e) as described below. Fidelis will submit a final Site Closure Plan and notify the permitting agency at least 120 days prior to its intent to close the site. Once the permitting agency has approved closure of the site, Fidelis will plug or transfer to another permit all wells and submit a site closure report to EPA. The activities, as described below, represent the planned activities based on information provided to EPA. The actual site closure plan may employ different methods and procedures. A final Site Closure Plan will be submitted to the UIC Director for approval with the notification of the intent to close the site.

9.6.1 Plugging Monitoring Wells

Prior to plugging the wells, the external integrity of each well will be confirmed by reviewing the DTS temperature profile and comparing to previous temperature profiles to ensure that no deflections have developed that may indicate a problem with external well integrity. In addition, PNC logs will be run in the wells prior to plugging to confirm that CO_2 has not migrated out of the storage formation.

The Well Plugging Plan for the injection well can be found in Permit Section 8.0. The same approach will be used to plug the deep monitoring and ACZ wells. Plugging and abandonment of these wells will meet all requirements set forth by the Class VI regulations. The perforated zone of the well will be plugged using a retainer method and the upper portions of the well will be cemented with a balance method. In addition, the portion of the casing within the storage formation in the deep monitor wells will be plugged using CO_2-resistant cement. The wells will have the casing cut off 5 ft below grade and a steel cap will be welded to the top of the deep casing string. The cap will have the well identification (ID) number and the date of plugging and abandonment inscribed on it. The following provides a preliminary plan for plugging the deep monitor and ACZ wells.

1. Conduct and document a safety meeting.
2. Move-in (MI) pulling and reverse units and ancillary equipment onto well site and rig up (RU). Nipple up and test blow out preventors (BOPs), pressure test equipment and ensure proper operation.
3. Verify wellhead tubing and casing pressures are at zero.
4. Record bottom-hole pressure from downhole gauge (if final pressure has not already been determined) and calculate kill fluid density.

5. Fill tubing with kill weight brine as determined by the final pressure measurement. Inject two tubing volumes of kill weight brine. Monitor tubing and casing pressure for 1 hour.
6. If the well is not dead or the pressure cannot be bled off the tubing, rig up slickline and set plug in lower profile nipple below packer. Unstab the tubing and circulate tubing and annulus with kill weight fluid until well is dead.
7. Release packer and pull out of hole with injection tubing laying it down. NOTE: Ensure that the well is over-balanced so there is no backflow due to formation pressure and there are always at least two well control barriers in place.
8. Trip into hole with work string with cement retainer to approximately 100 ft above the top perforation, set retainer to cement the perforated portion of the well, and prepare for cement plugging operations. Pump the specified number of sacks of cement through the retainer while maintaining bottom-hole pressure below fracture pressure. If it appears that the injection pressure will exceed the fracture pressure and the total amount of cement has not been pumped into the storage formation, cement pumping will cease. The tubing will then be pulled out of the retainer and any remaining volume of cement will be spotted on top of the retainer.
9. If a second perforated zone is present in the well, repeat Step 8 for upper perforated zone.
10. Trip workstring out of well and remove stinger from end of tubing.
11. Trip tubing open-ended to intermediate casing shoe depth and spot Class C balanced plug across intermediate casing shoe depth.
12. Trip tubing to deep surface casing shoe depth and spot 12 sack Class C balanced plug across deep surface casing shoe depth.
13. Trip tubing string to a depth of 500 ft and prepare to set third cement plug. Pump approximately 60 sacks of Class C cement to fill the casing from a depth of 500 ft to near surface.
14. Cut the casing string off at 5 ft below grade and weld a steel plate, (with well ID, permit number, and date of abandonment on it) to the casing strings.
15. Backfill the well cellar.
16. Rig down and move off pulling unit and all remaining equipment.

Specific well designs for the deep monitoring and ACZ wells are still to be determined. When available, specific cement volumes will be provided.

Following the plugging and abandonment of the monitoring wells, the above ground infrastructure, such as wellheads, monitoring equipment, etc., will be removed, and the area

around the wells will be regraded to follow the natural topography of the surrounding area (currently agricultural fields) unless the surface owner desires the well pad be left in place. The ground will be replanted with either native vegetation or be converted back to agricultural land, as warranted relative to the surface owner's desire.

9.6.2 Site Closure Report

A site closure report will be prepared and submitted within 90 days following site closure, documenting the following:

- Plugging of the monitoring wells
- Notifications to state as required by 40 CFR 146.93(f)(2)
- Records regarding the nature, composition, volume of the injected CO_2, and post-injection monitoring.
- Project-owned groundwater monitoring wells may be converted to use as groundwater wells if desired by the surface owner.

Fidelis will record a notation to the property's deed on which the injection well was located that will indicate the following:

- That the property was used for CO_2 sequestration
- The volume of fluid injected
- The formation into which the fluid was injected, and the period over which the injection occurred.

The site closure report will be submitted to the permitting agency and maintained by the owner or operator for a period of 10 years following site closure. Additionally, the owner or operator will maintain the records collected during the post-injection period for a period of 10 years after which these records will be delivered to the UIC Director.

9.6.3 Quality Assurance and Surveillance Plan (QASP)

The QASP is presented in Appendix A of the Testing and Monitoring Plan (Permit Section 7.0).