ATTACHMENT E: POST-INJECTION SITE CARE AND SITE CLOSURE PLAN 40 CFR 146.93(a)

CLEAN ENERGY SYSTEMS MENDOTA

1. Facility Information

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This Post-Injection Site Care and Site Closure (PISC) plan describes the activities that Clean Energy Systems will perform to meet the requirements of 40 CFR 146.93. Clean Energy Systems will monitor ground water quality and track the position of the carbon dioxide plume and pressure front for fifty (50) years. Clean Energy Systems may not cease post-injection monitoring until a demonstration of non-endangerment of USDWs has been approved by the UIC Program Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, Clean Energy Systems will plug all monitoring wells, restore the site to its original condition, and submit a site closure report and associated documentation.

This attachment is one of the several documents listed below that was prepared by Schlumberger and delivered to Clean Energy Systems. These documents were prepared to support the Clean Energy Systems preconstruction application to the EPA.

- Attachment A: Summary of Requirements Class VI Operating and Reporting Conditions (Schlumberger, 2021a)
- Attachment B: Area of Review and Corrective Action Plan (Schlumberger, 2021b)
- Attachment C: Testing and Monitoring Plan (Schlumberger, 2021c)
- Attachment D: Injection Well Plugging Plan (Schlumberger, 2021d)
- Attachment E: Post-Injection Site Care and Site Closure Plan (Schlumberger, 2021e)
- Attachment F: Emergency and Remedial Response Plan (Schlumberger, 2021f)
- Attachment G: Construction Details (Schlumberger, 2021g)
- Attachment H: Financial Assurance Demonstration (Schlumberger, 2021h)
- Class VI Permit Application Narrative 40 CFR 146.82(A) Clean Energy Systems Mendota (Schlumberger, 2021i)
- Quality Assurance and Surveillance Plan (Schlumberger, 2021j)

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1.1 Abbreviations

AoR: area of review
BFW: base of fresh water
BOP: blowout preventer
CES: Clean Energy Systems
DAS: distributed acoustic sensing
DTS: distributed temperature sensing
EPA: Environmental Protection Agency
GC-P: gas chromatography-pyrolysis
hDVS: heterodyne distributed vibration sensing
ICP: inductively coupled plasma
Mendota_ACZ_1: above-confining-zone monitoring well
Mendota_GW 1-4: nested shallow groundwater monitoring wells
Mendota_INJ_1: proposed CO_2 injection well
Mendota_OBS_1: injection zone monitoring well
Mendota_USDW_1: USDW monitoring well
MIT: mechanical integrity test
MS: mass spectrometry
MSL: mean sea level
OES: optical emission spectrometry
PISC: post injection site care
SOP: standard operating procedure
TD: total depth
TVDSS: true vertical depth subsea
UIC: underground injection control
USDW: underground sources of drinking water
VSP: vertical seismic profile

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2. Pre- and Post-Injection Pressure Differential [40 CFR 146.93(a)(2)(i)]

Based on the modeling of the pressure front as part of the AoR delineation, pressure at the injection well is predicted to decrease rapidly within 2 years after the cessation of injection. Note that the low critical pressure of 3.5 psi described in the Area of Review and Corrective Action Plan (Schlumberger, 2021b) maintains the pressure front even after the cessation of injection with a similar size plume AoR. However, no growth in the pressure front was found from the simulation results. Additional information on the projected post-injection pressure declines and differentials is presented in the Area of Review and Corrective Action Plan (Schlumberger, 2021b).

3. Predicted Position of the CO_2 Plume and Associated Pressure Front at Site Closure [40 CFR 146.93(a)(2)(ii)]

Figure 1 and Figure 2 show the predicted extent of the plume and pressure front at the end of the 10- and 50-year post-injection site care (PISC) timeframe. This map is based on the AoR delineation modeling results, pursuant to 40 CFR 146.84. See the Area of Review and Corrective Action Plan (Schlumberger, 2021b) for the AoR delineation in detail.

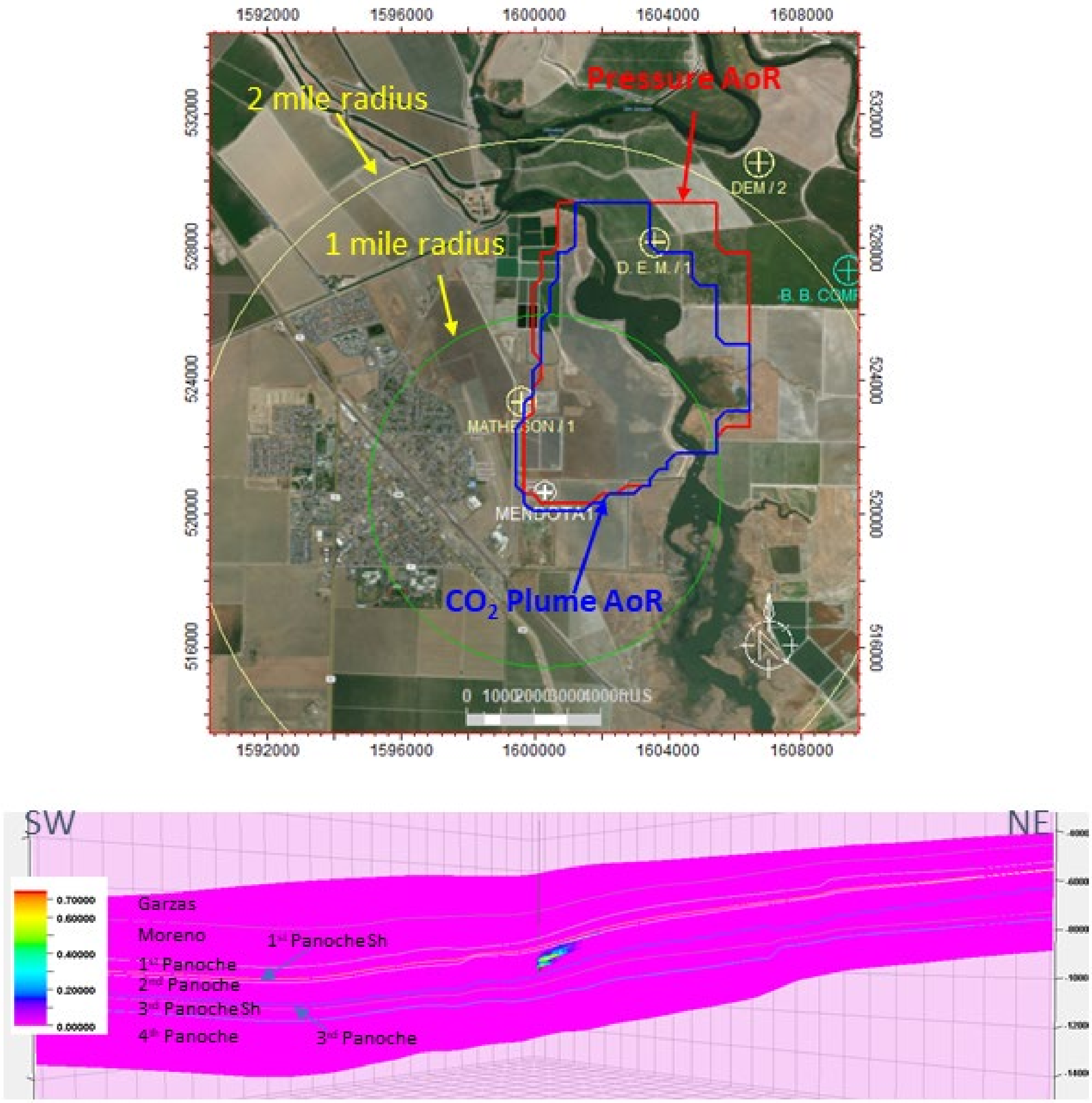

Figure 1. Predicted extent of the CO_2 plume and pressure front (ΔPc = 3.5 psi) after 10 years of PISC.

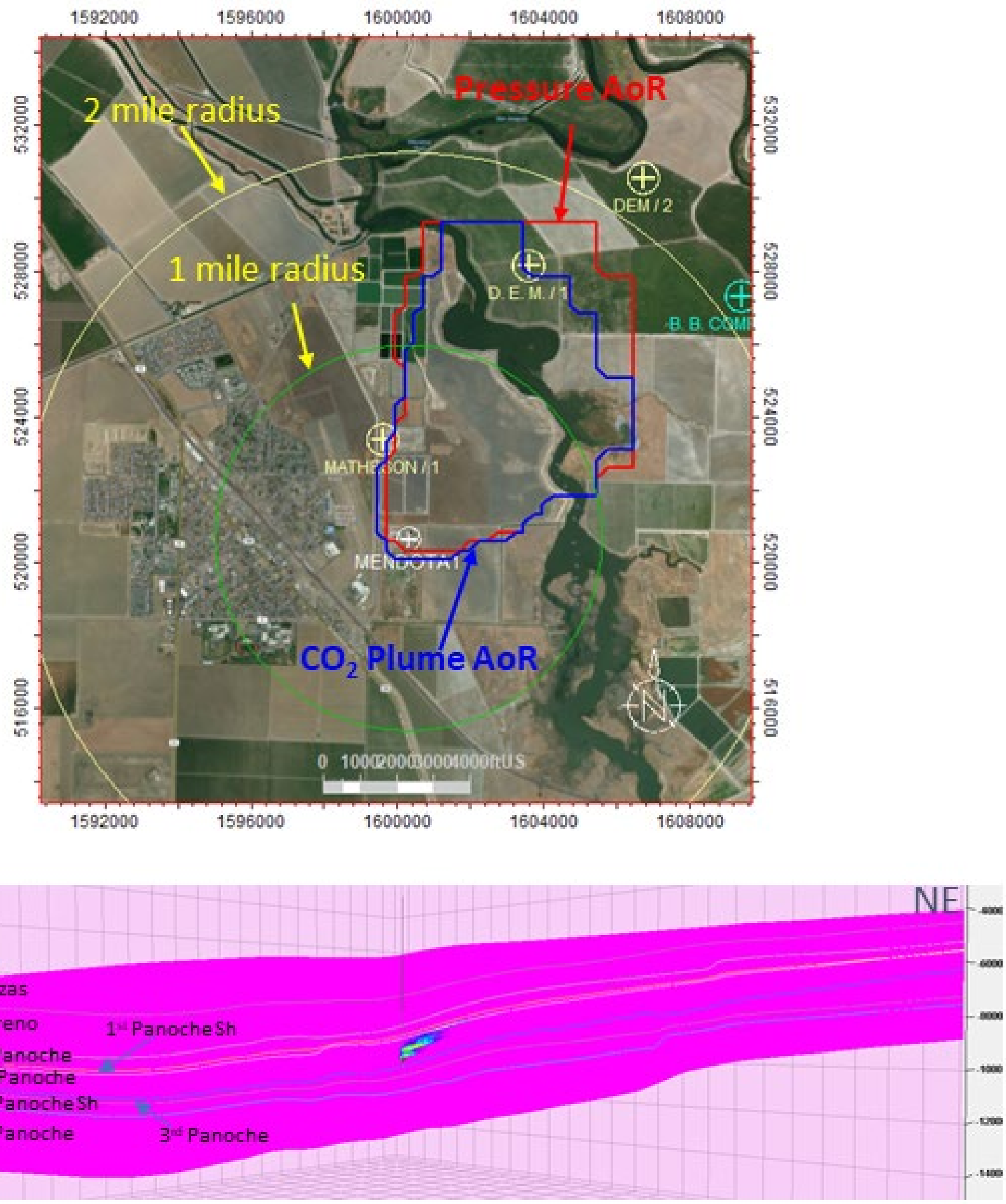

Figure 2. Predicted extent of the CO_2 plume and pressure front ($\Delta Pc = 3.5$ psi) after 50 years of PISC.

4. Post-Injection Monitoring Plan [40 CFR 146.93(b)(1)]

Performing groundwater quality monitoring above the confining zone and plume and pressure front tracking 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 phase testing and monitoring will be submitted annually, within 60 days of the anniversary date of the date on which injection ceases as described in Section4.2 Schedule for Submitting Post-Injection Monitoring, below. A quality assurance and surveillance plan (QASP) for all testing and monitoring activities during the injection and post injection phases is provided in the

Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j). Table 1 presents the monitoring methods, locations, and frequencies for monitoring above the confining zone. Table 2 identifies the parameters to be monitored and the analytical methods CES will employ.

Table 1. Monitoring of groundwater quality and geochemical changes above the confining zone.

Target Formation	Monitoring Activity[a]	Monitoring Location(s)	Frequency Year 1-3	Frequency Year 3-20	Frequency Year 20-50
Quaternary/shallow strata sources of drinking water	Fluid sampling	Shallow monitoring wells (Mendota_GW_1-4)	Annual	Annual	Annual
Santa Margarita or base of USDW (~1,400 ft TVDSS)	Fluid sampling	Mendota USDW_1	Annual	Annual	Annual
	DAS – distributed temperature/ acoustic	Mendota_ACZ_1 Mendota_OBS_1 Mendota_INJ_1	Continuous	None	None
Garzas (5604– 7132 TVDSS)	Fluid sampling	Mendota_ACZ_1	Annual	Year 5, 7, 10	None
	DAS – distributed temperature / acoustic	Mendota ACZ_1 Mendota OBS_1 Mendota INJ_1	Continuous	None	None
	Pulsed neutron	Mendota_ACZ_1	Year 1,3	Year 5, 7, 10	None
	Pulsed neutron	Mendota_OBS_1	Year 1, 3	Year 5, 7, 10	None

[a] Logging surveys will occur within 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

Table 2. Summary of analytical and field parameters for ground water samples.

Parameters	Analytical Methods [1]
Quaternary / Shallow strata sources of drinking water	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, Zn and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Total Dissolved Solids	Gravimetry; APHA 2540C
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
Hardness	ASTM D1126-17
Turbidity	ASTM D1126-17
Specific Gravity	ASTM D1429
Density	ASTM D3505-18
Santa Margarita or base of USDW	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, Zn and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry
Total Dissolved Solids	Gravimetry; APHA 2540C
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
Hardness	ASTM D1126-17
Turbidity	ASTM D1126-17
Specific Gravity	ASTM D1429

Parameters	Analytical Methods [1]
Density	ASTM D3505-18
Garzas	
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, Zn and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion Chromatography, EPA Method 300.0
Dissolved CO_2	Coulometric titration, ASTM D513-11
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry
Total Dissolved Solids	Gravimetry; APHA 2540C
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
Hardness	ASTM D1126-17
Resistivity	ASTM D1125-14
Turbidity	ASTM D1126-17
Specific Gravity	ASTM D1429
Density	ASTM D3505-18

[a] ICP, inductively coupled plasma; MS, mass spectrometry; OES, optical emission spectrometry; GC-P, gas chromatography - pyrolysis. An equivalent method may be employed with the prior approval of the UIC Program Director

Sampling will be performed as described in section B.2 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j); this section describes the groundwater sampling methods to be employed, including sampling standard operating procedures (SOPs) (section B.2.a/b), and sample preservation (section B.2.g).

Sample handling and custody will be performed as described in section B.3 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j).

Quality control will be ensured using the methods described in section B.5 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j).

Collection and recording of continuous monitoring data will occur at the frequencies described in Table 3.

Table 3. Sampling and recording frequencies for continuous monitoring.

Parameter	**Device(s)**	**Location**	**Minimum Sampling Frequency**[a]	**Minimum Recording Frequency**[b]
Continuous monitoring post-injection	DAS-DTS distributed temperature/acoustic	Mendota ACZ_1 Mendota OBS_1 Mendota INJ_1	10 seconds	60 minutes[c, d]

[a] Sampling frequency refers to how often the monitoring device obtains data from the well for a particular parameter. For example, a recording device might sample a pressure transducer monitoring injection pressure once every two seconds and save this value in memory.
[b] Recording frequency refers to how often the sampled information gets recorded to digital format (such as a computer hard drive). Following the same example above, the data from the injection pressure transducer might be recorded to a hard drive once every minute.
[c] This can be an average of the sampled readings over the previous 5-minute recording interval, or the maximum (or minimum, as appropriate) value identified over that recording interval.
[d] DTS sampling frequency is a minimum of once every 10 seconds and recorded on an hourly basis.

4.1 Carbon Dioxide Plume and Pressure Front Tracking [40 CFR 146.93(a)(2)(iii)]

CES will employ direct and indirect methods to track the extent of the carbon dioxide plume and the presence or absence of elevated pressure. Monitoring locations relative to the predicted CO_2 plume and pressure front will be determined after site-specific data are collected from a proposed characterization well. Table 4 presents the direct and indirect methods that CES will use to monitor the CO_2 plume, including the activities, locations, and frequencies CES will employ. CES will conduct fluid sampling and analysis to detect changes in groundwater to directly monitor the carbon dioxide plume. The parameters to be analyzed as part of fluid sampling in the Panoche (and associated analytical methods) are presented in Table 5. Table 6 presents the direct and indirect methods that CES will use to monitor the pressure front, including the activities, locations, and frequencies.

Fluid sampling will be performed as described in B.2 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j); sample handling and custody will be performed as described in B.3 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j); and quality control will be ensured using the methods described in B.5 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j). Quality assurance procedures for seismic monitoring methods are presented in B.9 of the Schlumberger Quality Assurance and Surveillance Plan (Schlumberger, 2021j).

Table 4. Post-injection phase plume monitoring [a,b]

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
Direct Plume Monitoring				
Panoche	Fluid sampling	Mendota_OBS_1	1-point location in injection interval: ~9,300 -9,600 ft MSL	Year 1, 3, 5, 7, and 10
Indirect Plume Monitoring				
Panoche	Pulsed neutron logging/ Pulsar* multifunction service	Mendota_INJ_1	Logged interval TD or below the Panoche injection interval to surface casing ~1,600 ft MSL	Year 1, 3, 5, 7, and 10
	Spinner survey	**Mendota_INJ_1**	**Logged interval from lowermost perforations to uppermost with multiple speed pass and station logs between perforations**	**Year 1, 3, 5, 7, and 10**
	Pulsed neutron logging/ Pulsar* multifunction service	Mendota_OBS_1	Logged interval TD or below the Panoche injection interval to surface casing ~1,600 ft MSL	Year 1, 3, 5, 7, and 10
	3D surface, or combination of borehole and surface seismic	Northern extent of plume area	Fold image coverage ~ 600 acres	Year 1, 5 and Year 10
Multiple	Passive seismic (DAS and/or geophones)	A combination of borehole and surface seismic stations located within the AoR.	The passive seismic monitoring system has the ability to detect seismic events over M1.0 within the AoR.	Continuous

[a] Sampling and geophysical surveys will occur within 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director. [b] Seismic surveys will be performed in the 4th quarter before or the 1st quarter of the calendar year shown or alternatively scheduled with the prior approval of the Director.

Table 5. Summary of analytical and field parameters for fluid sampling in the injection zone.

Parameters	**Analytical Methods** [a]
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb Se, **Zn** and Tl	ICP-MS, EPA Method 6020
Cations: Ca, Fe, K, Mg, Na, and Si	ICP-OES, EPA Method 6010B
Anions: Br, Cl, F, NO_3, and SO_4	Ion chromatography, EPA Method 300.0
Isotopes: $\delta^{13}C$ of DIC	Isotope ratio mass spectrometry
Dissolved gases: CO_2 , O_2, and H_2S	Coulometric titration, ASTM D513-11 EPA 360.1 ASTM D5705
Total Dissolved Solids	Gravimetry; APHA 2540C
Water Density(field)	Oscillating body method
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Specific conductance (field)	APHA 2510
Temperature (field)	Thermocouple
Resistivity	ASTM D1125-14
Hardness	ASTM D1126-17
Turbidity	ASTM D1126-17
[a] ICP, inductively coupled plasma; MS, mass spectrometry; OES, optical emission spectrometry; GC-P, gas chromatography - pyrolysis. An equivalent method may be employed with the prior approval of the Director.	

Table 6. Post-injection phase pressure-front monitoring.[a,b]

Target Formation	Monitoring Activity	Monitoring Location(s)	Spatial Coverage	Frequency
Direct Pressure Front Monitoring				
Panoche formation (First, Second, and Third Panoche sands	Pressure/ temperature monitoring	OBS_1	1-point location, 3 intervals: (~ -8,600, -9,400, -10,000 ft MSL)	Continuous 3 intervals until Year 10. Annually afterwards.
Panoche formation	Pressure/ temperature monitoring	INJ_1	1 point location, 1 interval: PT @ Perfs (~ -9,400-9,620 ft MSL)	Continuous until Year 10. Annually afterwards.
Garzas (USDW above confining zone)	Pressure/ temperature monitoring	ACZ_1	1 point location, 1 interval: PT @ Perfs (~ -7,250 ft MSL)	Continuous until Year 10. Annually afterwards.
Multiple	DTS	INJ_1/ OBS_1	Distributed measurement to ~ -9,200 ft MSL	Continuous until Year 10. Annually afterwards.
Other Monitoring				
Multiple	Passive seismic (DAS and/or geophones)	A combination of borehole and surface seismic stations located within the AoR.	The passive seismic monitoring system has the ability to detect seismic events over M1.0 within the AoR.	Continuous

[a] Collection and recording of continuous monitoring data will occur at the frequencies described in Table 1.
[b] Annual monitoring surveys will occur up to 45 days before the anniversary date of cessation of injection or alternatively scheduled with the prior approval of the Director.

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

All post-injection site care monitoring data and monitoring results collected using the methods described above will be submitted to EPA in reports submitted to the Director in annual reports. These reports will be submitted each year, within 60 days following the anniversary date of the date on which injection ceases or alternatively with the prior approval of the Director. 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.

5. Alternative Post-Injection Site Care Timeframe [40 CFR 146.93(c)]

This pre-construction application is not requesting an alternative PISC timeframe. CES shall continue to conduct post-injection site monitoring for at least 50 years or for the duration of any alternative timeframe approved pursuant to 40 CFR § 146.93(c). The alternative PISC timeframe, pursuant to 40 CFR 146.93(c)(1), will be based on the computational modeling used to delineate the AoR, predictions of plume migration, pressure decline, and CO_2 trapping. Once site-specific data (characterization well, 3D seismic data, etc.) have been acquired, CES will review the alternative PISC timeframe and request its approval from EPA if needed. The monitoring timeframe for monitoring above the confining zone (Table 1) and for carbon dioxide plume and pressure front tracking (Section 4.1) would be reviewed and modified accordingly when the alternative PISC timeframe is proposed.

Monitoring described in Table 1 for monitoring above the confining zone and in Section 4.1 for carbon dioxide plume and pressure front tracking and reporting the results as described in the schedule for submitting post-injection monitoring results (Section 4.2) will continue until CES demonstrates, based on monitoring and other site-specific data, that no additional monitoring is required to ensure non-endangerment to any USDWs, per the requirements at 40 CFR 146.93(b)(2) or (3).

6. Non-Endangerment Demonstration Criteria

6.1 Introduction and Overview

Prior to approval of site closure, CES will submit a demonstration of non-endangerment of USDWs to the UIC Program 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. All relevant monitoring data and interpretations, model documentation and all supporting data, and any other information necessary for the UIC Program Director to review the analysis will be provided in the report.

6.2 Summary of Existing Monitoring Data

A summary of all previous monitoring data collected at the site, pursuant to the Testing and Monitoring Plan (Schlumberger, 2021c) and this PISC and Site Closure Plan (Schlumberger, 2021e), including data collected during the injection and post-injection phases of the project, will be submitted to demonstrate non-endangerment. Data submittals will be in a format acceptable to the UIC Program 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)].

6.3 Summary of Computational Modeling History

The results of computational modeling used for AoR delineation and for demonstration of an alternative PISC timeframe if submitted will be compared to monitoring data collected during the operational and the PISC period. The methods for delineating the AoR described in the Area of Review and Corrective Action Plan (Schlumberger, 2021b) will be consistent throughout the life of the project. The data will include the results of time-lapse temperature and pressure monitoring, groundwater quality analysis, passive seismic monitoring, and geophysical surveys (i.e., logging; operating-phase vertical seismic profile, VSP; and 3D surface seismic surveys) used to monitor the site and to update the computational model. 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 the plume's properties and size. The operator will demonstrate the degree of accuracy by comparing the monitoring data obtained during the PISC period against the model's predicted properties (i.e., 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. Further, the validation of the complete model over the areas, and at the points, where direct data collection has taken place, will help to ensure confidence in the model for those areas where surface infrastructure precludes geophysical data collection and where direct observation wells cannot be placed.

6.4 Evaluation of Reservoir Pressure

CES will also support a demonstration of non-endangerment to USDWs by showing that, during the PISC period, the pressure within the injection zone rapidly decreases toward its pre-injection static reservoir pressure. Because the increased pressure during injection is the primary driving force for fluid movement that may endanger a USDW, the decay in the pressure differentials will provide strong justification that the injectate does not pose a risk to any USDWs.

The operator will monitor the downhole reservoir pressure at various locations and intervals using a combination of surface and downhole pressure gauges. The measured pressure at a specific depth interval will be compared against the pressure predicted by the computational model. Agreement between the actual and the predicted values will help validate the accuracy of the model and further demonstrate non-endangerment.

6.5 Evaluation of Carbon Dioxide Plume

A combination of time-lapse pulsed neutron logs, time-lapse VSP surveys, and other seismic methods (2D or 3D surveys) will be used to locate and track the extent of the CO_2 plume. A series of pulsed neutron logs will 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 represent the storage system. Similarly, a comparison of the time-lapse VSPs against the predicted spatial extent of the plume at a specified time interval will be made. Also, 3D seismic surveys will be employed to determine the plume location at specific times. The data produced by these activities will be compared against the model using statistical methods to validate the model's ability to accurately represent the storage site.

After monitoring sessions and acquisition of 3D time-lapse surveys (either surface seismic data or VSPs), the position of the modeled plume and pressure fronts will be compared to the measured position of the plume and pressure front, using maps, pressure profiles, and 3D methods. This will ensure that the plume and pressure front are behaving as predicted at various points in time. If the measured position of the plume and/or pressure front deviates from the modeled behavior, the program for plume/pressure front monitoring can be adapted to the measured geometry (for example, adjusting the coverage area of the time-lapse VSP).

6.6 Evaluation of Emergencies or Other Events

In addition to carbon dioxide, mobilized fluids may pose a risk to USDWs. These include native fluids that are high in salinity and therefore may impair a USDW and fluids containing mobilized drinking water contaminants (e.g., arsenic, mercury, hydrogen sulfide). The geochemical data collected from monitoring wells will be used to demonstrate that no mobilized fluids have moved above the seal formation and therefore after the PISC period would not pose a risk to USDWs. To demonstrate non-endangerment, the operator will compare the operational and PISC period samples from layers above the injection zone, including the lowermost USDW, against 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 no mobilized formation fluids have moved through the seal formation. This validation of seal integrity will help demonstrate that the injectate and or mobilized fluids would not represent an endangerment to any USDWs.

Additionally, pulsed neutron logs will be used to monitor the salinity of the reservoir fluids in the observation zone above the Moreno shale seal. By comparing the time-lapse pulsed neutron logs against the pre-injection baseline logs, the operator will be able to monitor any changes in reservoir fluid salinity. Pulsed neutron logs indicating steady salinity levels within each zone would indicate no movement of fluids out of the storage unit, confirming the integrity of the well and seal formation.

Finally, passive seismic monitoring will be used to help further demonstrate seal formation integrity. A clearer picture of the faulting at the site will be established after the 3D seismic data are acquired and interpreted, and the positions of the faults will be registered with the microseismic monitoring program. The location of microseismic events will be compared to the locations of the interpreted faulting from the 3D seismic data. The operator will provide seismic monitoring data showing that no seismic events have occurred that would indicate fracturing or fault activation near or through the seal formation. This validation of seal integrity will provide further support for demonstrating that the CO_2 plume is no longer an endangerment to any USDWs.

A table showing emergencies or other unanticipated events that may occur during the injection and post-injection phases is given in the risk register in Attachment F: Emergency and Remedial Response Plan (Schlumberger, 2021f). The relevant risk events are 2a – 6e in the risk number column of the register. The description of risk and equipment columns detail the risks and monitoring equipment for each event.

All relevant microseismic risk events that occurred over the injection period will be summarized at the conclusion of the injection phase, along with a description of how they were resolved such that there is no further concern that the USDWs are endangered.

7. Site Closure Plan

Clean Energy Systems will conduct site closure activities to meet the requirements of 40 CFR 146.93(e) as described below. Clean Energy Systems will submit a final Site Closure Plan and notify the permitting agency at least 120 days prior of its intent to close the site. Once the permitting agency has approved closure of the site, Clean Energy Systems will plug the monitoring 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 Program Director for approval with the notification of the intent to close the site.

7.1 Plugging Monitoring Wells

Prior to commencing plug and abandonment operations, Clean Energy Systems shall obtain required regulatory permits and prepare site for starting operations and completing operations including removal of all relevant landscaping and lighting fixtures, surface piping and electrical components, and constructing a cement pad of those dimensions that meet regulatory requirements.

Clean Energy Systems shall use materials designed and deemed fit-for-purpose for use in CO_2 environments, and meeting regulatory requirements, including but not limited to

- Class D, G, H, and CO_2-resistant cements
- Engineered drilling mud
- Bridge plugs and cement retainers designed for CO_2 environments

Clean Energy Systems shall use one or more of the following tests or surveys to confirm well integrity prior to plugging, including but not limited to

- Internal mechanical integrity tests (MIT), e.g., surface pressure tests, leakoff pressure tests
- External MITs, e.g., ultrasonic and acoustic cement evaluation logs and the casing integrity logs, multi-arm caliper and magnetic flux leakage
- Noise/temperature logs
- Fiber optic sensors utilizing DTS or heterodyne distributed vibration sensing (hDVS) technologies.

The procedures described below are meant to provide a generalized overview of a typical plug and abandonment program. Well specific procedures will be created and submitted prior to starting operations. Procedures are subject to modification during execution as necessary to ensure a plugging operation that protects worker safety and is effective to protect USDWs, and any significant modifications due to unforeseen circumstances will be described in the plugging report. Complete plugging forms with charts and all laboratory information will be submitted to the regulatory agency as required by permit. Plugging report shall be certified as accurate by CES and plugging contractor and shall be submitted within 60 days after plugging is completed.

- Wellsite will be prepared by removing all relevant landscaping and lighting fixtures and surface piping and electrical components as needed.
- Move in workover rig. Spot fluid tanks and load with fluid.
- Install plug in tubing/casing to isolate downhole pressure and remove tree.
- Install appropriate pressure rated blowout preventer (BOP) equipment in accordance with permit. Pressure test connections and BOP as per permit requirements.
- For wells with tubing and packer completions, unlatch tubing from packer, pull out of hole and lay down tubing or run in hole with workstring and retrieve packer.
- Run in hole with tubing and clean out as required. Tag and determine bottom.
- Perform internal MIT by applying surface pressure to casing. Confirm or remediate as required.
- Perform external MIT by running wireline log to determine cement coverage and quality. Ensure cement coverage meets regulatory requirements. As well, casing integrity, e.g., internal radius and thickness, can be evaluated using wireline logs.
- Perform cement squeeze as required to meet regulatory cement requirements.
- Lay cement plugs and abandonment mud inside production casing according to regulatory guidelines.
- Cut and remove production casing at required depth, usually above surface casing shoe. Perform injection test on surface casing shoe.
- Pending injection test results, either lay cement plug across surface casing shoe or set cement retainer and squeeze cement into surface casing shoe.
- Lay cement plugs inside surface casing as per regulations. Note: If the base of fresh water BFW is shallower that the surface casing shoe then the cement quality across BFW must be verified by either reviewing an existing log or running a cement bond log.
- If unsatisfactory cement present at BFW then shoot and squeeze cement as required.
- Cut casing 5-10 ft below surface. Build cement pad and install well identification plate.
- Rig down, move out workover rig.

7.2 Site Closure Report

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

- Plugging of the verification and geophysical wells (and the injection well if it has not previously been plugged)
- Location of sealed injection well on a plat of survey that has been submitted to the local zoning authority
- Notifications to state and local authorities as required at 40 CFR 146.93(f)(2)
- Records regarding the nature, composition, and volume of the injected CO_2
- Post-injection monitoring records

Clean Energy Systems 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 carbon dioxide sequestration
- The name of the local agency to which a plat of survey with injection well location was submitted
- The volume of fluid injected
- The formation into which the fluid was injected
- 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 Program Director.

8. Quality Assurance and Surveillance Plan (QASP)

The Schlumberger Quality Assurance and Surveillance Plan is presented in Schlumberger (2021j).

9. References

Schlumberger. (2021a). *Attachment A: Summary of Requirements Class VI Operating and Reporting Conditions.*

Schlumberger. (2021b). *Attachment B: Area of Review and Corrective Action Plan 40 CFR 146.84(b) Clean Energy Systems Mendota.*

Schlumberger. (2021c). *Attachment C: Testing and Monitoring Plan 40 CFR 146.90 Clean Energy Systems Mendota.*

Schlumberger. (2021d). *Attachment D: Injection Well Plugging Plan 40 CFR 146.92(B) Clean Energy Systems Mendota.*

Schlumberger. (2021e). *Attachment E: Post-Injection Site Care and Site Closure Plan 40 CFR 146.93(A) Clean Energy Systems Mendota.*

Schlumberger. (2021f). *Attachment F: Emergency and Remedial Response Plan 40 CFR 146.94(A) Clean energy Systems Mendota.*

Schlumberger. (2021g). *Attachment G: Construction Details Clean Energy Systems Mendota.*

Schlumberger. (2021h). *Attachment H: Financial Assurance Demonstration 40 CFR 146.85 Clean Energy Systems Mendota.*

Schlumberger. (2021i). *Class VI Permit Application Narrative 40 CFR 146.82(A) Clean Energy Systems Mendota.*

Schlumberger. (2021j). *Schlumberger Quality Assurance and Surveillance Plan.*