Evaluation of Updated MCNEP Class VI Permit Application
(submitted September 2021)

*On September 22, 2021, MCNEP responded to EPA's technical comments on an updated permit application submitted in June 2021. This document contains the requests provided by EPA in August 2021 (in red), along with our evaluation and follow up questions (in **blue**).*

Overall follow-up request: Attachments A-H of the permit application if approved by EPA will be incorporated into the permit. Please provide a version of these attachments without the disclaimer page.

Overall follow-up request: Please add the permit number (R9UIC-CA6-FY20-1) to the footers of each attachment. This was added to the narrative and all of the project plans. No further questions.

Geologic Site Characterization

- Please incorporate all of the clarifications to the geologic description in CES's responses to RAI 1 into the updated permit application. Also, incorporate the revisions CES described in their responses to RAI 5, with the following changes:
  - In Figures 2a–2d, EPA recommends maintaining the same wellbore position in Figure 2b (likely scenario) and Figure 2c (modeled scenario) to demonstrate the most likely depositional scenario and well location proposed for the modeling effort. Also, please retain the inserted sand polygon in Figure 2c to demonstrate possible reservoir connectivity and the conservative modeling approach (see p. 10 of CES's response). Changes were made. The wellbore was kept in same position between Figures 4b and 4c, and the sand polygon was retained in Figure 4c. The description of lateral confinement is sufficient given the current state of the project and data interpretation to date. Updates will be made once additional pre-operation testing is performed (3D seismic acquisition). No further questions.
  - Please confirm that no additional data on perforation depths for wells API 3900052, 3900053, and 3900057 and the two production wells at Gill Ranch Gas Field mentioned in the Conservation report is available in existing well data repositories (IHS, Enverus, etc.). If the perforation depths are available, please note at what depth and approximate geologic formation the perforations occur (p. 19 of CES's responses to RAI5). Addressed – Table 8 describes the wells/perforations and explains comparable depositional environments.
  - Regarding seismic history, please discuss the amount of time over which the microseismic baseline will be determined and why this duration was chosen. Assuming the microseismic baseline will only capture geologically-recent seismicity, also attempt to establish an historic seismicity baseline using USGS and CEMA seismic data, integrated with known/interpreted faults in the AoR (p. 31 of CES's responses to RAI 5). Establishment of the timeframe for the seismic baseline is pending, per the updated application. No further questions.
  - Please provide a description of the advantages and limitations of the Heterogeneous Rock Analysis for facies assignment and the resulting facies porosity assignments. Added to Section 2.4.2.

Follow-up request on the permit application narrative:

- ***Figure 5 in Appendix A to CES's response to RAI 3 (Porosity-permeability crossplots of well logs vs. facies type (sand and shale)) is not in the updated application narrative; please include it in the updated application narrative.*** The requested crossplot was not added to the narrative.

Additionally, the narrative should be updated to reflect that a stimulation plan (EPA has provided MCNEP with an example of a generic simulation plan on October 28, 2021) is included in the application. A proposed stimulation program (Attachment I) is expected to be submitted in the permit application.

Follow-up requests on the permit application narrative:

- ***Please incorporate the requested porosity-permeability crossplot (Figure 5 in Appendix A to CES's response to RAI 3) into the narrative.***
- ***Please update the narrative to reflect that a stimulation plan (Attachment I) is attached.***

Operating Procedures

- Incorporate the updated tables in the response to RAI 3 into the operatingprocedures. Addressed.
- Update the "Summary of Requirements Class VI Operating and Reporting Conditions" with a revised annulus pressure of 5,777 psi. Addressed.
- Provide the type and name of the steady state multiphase simulation software used to determine the gas gradient of 0.376 psi/ft. Addressed.

AoR and Corrective Action Plan

- Please update the plan overall to incorporate the clarifications provided in responses to EPA's questions in RAIs 3, 4, and 5. Also, confirm that all updated tables and figures are included and the inconsistences in Table 1 of the responses to RAI 3 are addressed. Addressed.
- Revise the procedures and timing for AoR reevaluations and triggers for unscheduled AoR reevaluations as described in the responses to RAI 3 and RAI 5. Addressed.
- Update the corrective action plugging schematics for the Amstar and BB Co 1 wells to reflect the use of CO2-resistant cement. Addressed, however the Corrective Action Plan does not explicitly state that both wells in the AoR will be plugged prior to commencing injection; see follow-up request on this plan below.
- Include the verified locations of water wells in the AoR. Addressed.

Follow-up request on the AoR and corrective action plan:

- ***Please explicitly state in the AoR and Corrective Action Plan that the Amstar and BB Co 1 wells will be properly re-plugged prior to commencing injection.*** The AoR and Corrective Action Plan and the permit application narrative have been updated to state that the Amstar 1 and BB Co 1 wells may require corrective action and that final remediation plans for these wells will be informed by updated plume simulations after site-specific data are acquired. It adds that the Amstar 1 well does not penetrate the confining zone and is 1.5 miles downdip/away from the direction of plume movement, and the BB Co 1 well is 2.32 miles away and will not be intersected by the plume. Thus, the application does not state that corrective action will definitely be performed; instead, it defers a determination of the need pending the updated modeling. EPA has raised concerns in its initial application review about the construction and plugging of the two wells because they currently have only one relatively shallow casing installed and were open-hole plugged and abandoned. Please note that EPA will not issue authorization to inject without updated information and any needed corrective action on the two wells. We have no further questions at this time.

Testing and Monitoring Plan

CO2 Stream Analysis

- Add Ar, H_2, and δ13C to the injectate analysis parameters in Table 1 of Attachment C. Addressed.

Corrosion Monitoring

- Update the long-string equipment coupon description in Table 5 of Attachment C. Addressed.

Pressure Fall-Off Testing

- Clarify that PFOTs will be conducted every 5 years. Addressed.

Groundwater Quality Monitoring

- Include the updated site map in Figure 4-1 from the response to RAI 4. Addressed.
- Update Table 6 to match Table 4-2 in Appendix A of the response to RAI 4. See follow-up requests on this plan below.
- Add zinc, specific gravity, turbidity, hardness, and water density to the groundwater quality monitoring parameters in Table 7 of Attachment C. Addressed.
- Update the statement on Page 17 as follows: "To meet the requirements at 40 CFR 146.95(f)(3)(i), Clean Energy Systems will also monitor groundwater quality, geochemical changes, and pressure in the first USDWs immediately above the injection zone(s)." Addressed.

CO2 Plume and Pressure Front Monitoring

- Please revise Table 9 of Attachment C as follows:
  - Add injection profile monitoring (Spinner) surveys in INJ1. Addressed.
  - CO_2 monitoring in OBS1 will occur quarterly in years 0 to 2 and annually thereafter. This change was not made. See follow-up requests on this plan below.
  - Add DAS as a plume monitoring technique. Addressed.
- Add the following parameters mentioned in the pre-operational testing objectives to characterize the geochemistry of the Panoche Formation to Table 10: resistivity, turbidity, total hardness, and dissolved gases (H_2S, CO_2, O_2, etc.). Addressed.
- Add pressure monitoring in ACZ1 to Table 11 of Attachment C. Addressed.
- Describe the planned resolution and extent of the 3D seismic surveys. Addressed.
- Describe how VSP and 3D seismic data will be integrated to track plume movement. Addressed.

Quality Assurance Procedures

- Remove total hydrocarbons and SO_2 from the injectate parameters in the QASP. Addressed.

Follow-up requests on the testing and monitoring plan:

- ***A few changes to Table 6 of Attachment C are needed:***
  - ***Ground water quality monitoring in the quaternary strata and Santa Margarita should be quarterly (not annual) from year 3 to end of injection.*** Edited as requested.
  - ***In the notes to Table 6, please include the previous note about the dates of semi-annual sampling.*** Not added; however, there is no semi-annual sampling in the table. No further questions.
- ***Please revise Table 9 of Attachment C to indicate that CO_2 monitoring in OBS1 will occur 3, 6, 9, 12, 15, 18, 21, and 24 months after commencement of injection, then annually thereafter.*** The table and notes were edited as requested.
- ***The added Figures 5, 6, and 7 of Attachment C showing the post-injection positions of the plume and pressure front are not needed in the injection phase Testing and Monitoring Plan. Consider moving them to the PISC and Site Closure Plan.*** These figures were removed as requested.

Injection Well Plugging Plan

- Incorporate revisions to Table 2 of Attachment D (plugging details for Plug #3). See follow-up requests on this plan below.
- Include the revised injection well and monitoring well plugging schematics presented in CES's responses to RAI 4 and RAI 5. Addressed; note inconsistencies with procedures below.
- Revise the narrative description of plugging procedures as described in the responses to RAI 4 and RAI 5. See follow-up requests on this plan below.

Follow-up requests on the injection well plugging plan:

- ***The top of plug No. 3 is shown as 1,409 feet in Table 2 of Attachment D while the***

plugging and abandonment schematics of the attachment show the top of plug No. 3 at 1,509 feet. Please correct this inconsistency. Edited as requested and both now reflect 1,509 feet; no further questions.

- ***Comments on the plugging procedures for the INJ-1 well; several also apply generally to the OBS-1 well and ACZ-1 well:***
  - ***The schematic diagrams for the injection and monitoring wells show the base of USDWs at 1,609 feet with the top of a cement plug placed at 1,509 feet and the bottom of the plug at 1,900 feet and below the surface casing shoe at 1,800 feet, which is not consistent with the MCNEP responses in RAI 5. The latter schematics show the base of USDWs at 1,415 feet with a cement plug placed at 1,315 to 1,515 feet. Please clarify and/or correct this inconsistency.*** Changes were made to Table 2 and all three schematics to show the plug from 1,509-1,900 feet; no further questions.
  - ***The first bullet says, "Notify by phone California Department of Conservation a minimum of 24 hours prior to moving in rig." Please add EPA Region 9 to this notification step.*** Edited as requested.
  - ***Placement of the bottom plug is described as follows: "Pump 10-bbl fresh water and then mix and pump 28-bbl CO2-resistant cement with .5% dispersant. Mix at 15.8 ppg and yield 1.08 ft3/sk. Displace cement to spot as balanced plug." This is not consistent with the schematic in Figure 1 wherein the bottom cement plug is shown as placed in two steps, 400 feet in each step. Please clarify or correct this inconsistency.*** Table 2 was updated to reflect 28 bbl; no further questions.
  - ***The test pressure is stated as follows: "Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure. The test pressure for the internal mechanical integrity test in Part 3 of Appendix D requires 1,000 psig to be applied." For consistency, The P&A test pressure should be 1,000 psig. Please correct or explain why 1,000 psig is not applied during P&A operations.*** Edited as requested to read 1,000 psig; no further questions.
  - ***In preparation for placing plug No. 3, the procedure states: "Trip out of hole laying down workstring to +/- 1,800 ft. Pump 10-bbl fresh water and then mix and pump 22-bbl Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 ft^3/sk. Displace cement to spot as balanced plug." The workstring should be placed at 1,900 feet for placement of plug No. 3 from 1,900 to 1,509 feet as specified in the P&A schematic in Figure 1 of Appendix D. Please revise the P&A procedure accordingly.*** This was added to the procedures for INJ-1, but not for the ACZ-1 and OBS-1 wells.

Follow-up request on the injection well plugging plan:

- ***Please update the plugging procedures for the OBS-1 and ACZ-1 wells to reflect that the workstring should be placed at 1,900 feet for placement of plug No. 3 from 1,900 to 1,509 feet.***

Post-Injection Site Care and Site Closure Plan

- Include the recommended revisions to the non-endangerment demonstration criteria described in the responses to RAI 3. See follow-up requests on this plan below.
- Update tables related to post-injection groundwater quality monitoring and CO2 plume and pressure front monitoring to match those in the Testing and Monitoring Plan (see above). See follow-up requests on this plan below.
- Add DAS as a plume tracking technique to Table 4 of Attachment E. Addressed.
- In Table 6 of Attachment E, add OBS 1 to the DTS row and change DTS monitoring to 10-year monitoring, in line with the pulsed neutron logging plan. Addressed.

Follow-up requests on the post-injection site care and site closure plan:

- ***To clarify how the information in the Risk Register will support the non-endangerment demonstration, EPA recommends that the discussion in Section "6.6 Evaluation of Emergencies or Other Events" also include a summary of any such events that occurred during the project and a description of how these have been resolved such that there is no further concern that USDWs are endangered.*** A discussion of evaluating microseismic events was added; no further questions.
- ***Please also explain that the non-endangerment demonstration criteria will discuss the predicted behavior of the CO_2 plume and pressure front, supported by maps and graphs (e.g., of pressure profiles or extent of the plume and pressure front) in the context of the data that will be collected to demonstrate that the plume and pressure front are behaving as predicted at various points in time.*** This information was added to Section 6.5; no further questions.
- ***In Table 4, please add injection profile monitoring (Spinner) surveys in INJ1 for consistency with the Testing and Monitoring Plan.*** Edited as requested; spinner surveys will be performed throughout the logged interval and on the same schedule as other plume monitoring; no further questions.
- ***Also, there is a typo, "Mendot" under indirect plume monitoring in Table 4.*** Edited as requested.
- ***Please update Table 5 to include analytical parameters that match the injection-phase sampling of the injection zone by adding: Zn, resistivity, turbidity, total hardness, and dissolved gases (H_2S, CO_2, O_2, etc.).*** Edited as requested; however, the test method for turbidity is incorrect (it reflects the hardness method) and should be EPA Method 180.1 (this should be fixed in Table 2 as well).
- ***In Table 6, please add pressure monitoring in ACZ1 to continue from the injection phase monitoring.*** Edited as requested to clarify that monitoring will be continuous for 10 years and annually thereafter. No further questions.

Note also that MCNEP has removed reference to the 10-year alternative post-injection site care timeframe (as requested by EPA on August 19, 2021), and the revised PISC and Site Closure Plan notes that MCNEP will review site-specific data and request approval for an alternative PISC timeframe from EPA if needed. We have no further questions at this time.

Follow-up request on the post-injection site care and site closure plan:

- ***Please update the analytical method for turbidity in Tables 2 and 5 to be EPA Method 180.1.***

Emergency and Remedial Response Plan

- Section 4.1 should reference risk register scenario 1. Addressed.
- Please add "Limit access to wellhead to authorized personnel only" to section 4.1 and the magenta and red levels of the seismicity table. Addressed.
- In section 4.2, "Limit access to wellhead to authorized personnel only" should be under the response action, not the description of the scenario. Addressed.
- Add pressure monitoring and surface and periodic visual inspections to the response actions for the "Potential Brine or CO_2 Leakage to USDW" scenario as described in the response to RAI 5. Addressed.
- Note that the control room technician is a 24-hour number. Addressed.
- Please fix the typographical errors throughout the text. Addressed.

Follow-up requests on the emergency and remedial response plan:

- ***There are some minor suggested edits:***
  - ***Scenario 4.1, timing of event – a blowout would not happen in the injection phase.*** MCNEP

explained how this could be an injection-phase event; no further questions.
  - ***Scenario 4.2, timing of event – it would be clearer if the terminology matched the Class VI project phases, i.e., injection, post-injection.*** Edited as requested; no further questions.
  - ***Scenario 4.4, detection methods: is atmospheric monitoring being performed (or does this refer to use of hand-held air-quality monitors)?*** Edited to clarify that hand-held monitors will be used; no further questions.
  - ***Section 4.5, avoidance measures: should be N/A.*** Edited as requested; no further questions.
- ***Please incorporate the E&RR plan into the site safety plan.*** The safety plan document is not part of the UIC permit application package; however, EPA will need to see the site safety plan.

Follow-up request on the emergency and remedial response plan:

- ***Please provide a copy of the site safety plan that includes the Class VI Emergency and Remedial Response Plan when it has been updated.***

Injection Well Construction Plan

- Incorporate updated schematics and Tables 13 and 14 and the associated narratives from the responses to RAI 4. The updated schematics were provided, along with construction details for the monitoring wells. There appear to be some inconsistencies, however; see follow-up requests on this plan below.
- Incorporate the well schematics and tables for the monitoring wells into the plan. Addressed.
- Update the injection well schematic to show continuous monitoring gauge placement and type (per Figure 5-1 of response to RAI 4). Addressed.
- Provide all relevant well construction design, scope, and execution information prior to commencing monitoring well construction. Addressed.

Follow-up requests on the injection well construction plan:

- ***Please address the following (ensuring that any changes to the schematics are consistent with the Plugging Plan as needed):***
  - ***Tubing depth of INJ_1 is at 9,515 ft in the schematic and 9,430 ft in Table 3.*** Edited as requested.
  - ***Packer of ACZ_1 is at 7,177 ft in the schematic but 7,717 ft in Table 14.*** Edited as requested.
  - ***Packer of USDW_1 is at 1,594 ft in the schematic and 1,360 ft on Table 19.*** Edited as requested.
  - ***Several of the figures (e.g., Figures 3, 4, and 5) are mis-numbered.*** Edited as requested.
- ***Please provide a discussion of CES's study of the extent of subsidence in the project area and proposed subsidence mitigation measures in this plan.*** This was not provided in the application. However, on October 28, 2021 MCNEP met with EPA and CalGEM staff to discuss their initial study of the extent of subsidence in the project area. MCNEP will work with CalGEM staff to acquire specific records/reports on wells that were affected by subsidence in the project area by end of November 2021.

Follow-up requests on the injection well construction plan:

- ***Please provide the requested discussion of the extent of subsidence in the project area and any proposed subsidence mitigation measures in the application.***

Pre-Operational Testing Plan

The following updates to the formation testing plan are needed to incorporate the site characterization objectives described in the responses to RAI 1. Please include the names of the formations/zones that will be subject to each measurement/evaluation method described in the plan, as applicable.

- *To support the geomechanical and petrophysical characterization*, specify the core analysis methods (e.g., mercury injection capillary pressure, fracture analysis, triaxial compression testing,

stress, ductility, rock strength, elastic properties, and in situ fluid pressures, etc.) that will be used. Addressed in sections 3.2.4.5 and 3.2.4.6 of Attachment G, Core Testing Program. RCA and SCAL will be performed, covering the analyses listed here.

- *To characterize the mineral composition of the injection zone,* describe the proposed coring program (i.e., coring method, number of core barrels to be used if whole core, core depths, total footage, etc.) and the evaluation methods to be used. Addressed in section 3.2.4.5 of Attachment G, with uncertainties noted (total footage depends on operational success). Core depths are not specified but this is ok; CES mentions the formations to be cored instead of depths (approximate formation depth listed in Figure 55 of CES's updated permit application narrative.

- *For the seismic risk evaluation,* incorporate geomechanical information (dipole sonic logs), formation microimager (FMI) logs, and microseismic monitoring into the analysis. If a VSP is planned, please specify the type and intended analysis. Addressed.
- Describe the following data collections to *verify CO2 stream compatibility with subsurface fluids and minerals:*
  - Autoclave CO2-water-rock reaction experiments with core and water samples. Addressed.
  - Aqueous chemistry data that will be used to calibrate geochemical modeling. Addressed.
  - BET measurements on the core samples. Addressed.
- Describe *baseline geochemical testing* to confirm the TDS content of the Jergins and Blewett formations within the Moreno Shale. Not explicitly discussed. See follow-up request on this plan below.

The following updates to the well testing plan are needed:

- Add caliper logs to the logging program before surface, intermediate, and long string casing are installed. Addressed.
- Add temperature logging after each casing string is set and cemented. Addressed.
- Incorporate the requested changes to PFOT procedures in Attachment G and Attachment C. Addressed.
- Remove all references to a "petition" in the PFOT procedures. Addressed.

Follow-up request on the pre-operating testing plan:

- ***The updated application (Section 2.7.1 of the permit application narrative) states, "water samples will be collected within the Jergins and Blewitt formations (when water is present) and analyzed to confirm whether the formations are USDWs." Please include this sampling as the core acquisition/testing or the MDT/fluid sample acquisition in the intermediate and TD sections of the Mendota_INJ_1 injection well (Sections 3.2.3 and 3.2.4 of Attachment G).*** Text was added to Sections 3.2.3.3 and 3.2.4.3 on "Pressures, Permeability, Fluid Samples, Calibrate Geomechanics/Formation Stress" to indicate that the modular dynamic testing that will be performed at the intermediate and total depth sections of the wellbore is "for the purpose of fluid sampling (baseline geochemical testing) and pressures." No further questions.

Financial Responsibility Demonstration

No updated financial responsibility information was provided in June 2021.

- Submit revised and documented third-party cost estimates.
- Provide draft financial instruments.
- The financial instruments will need to be at least partially funded before EPA authorizes construction of the injection well.

Follow-up request on the financial responsibility demonstration:

- ***Please provide updated financial responsibility information.*** This was not provided (MCNEP will request a discussion meeting with EPA).