

Evaluation of Operating Procedures in the San Joaquin Renewables Class VI Permit Application

In June 2022, EPA provided questions presented in *blue italicized text* to San Joaquin Renewables (SJRenew) about the operations portion of SJRenew's Class VI permit application (dated October 13, 2021) for the proposed SJRenew Class VI geologic sequestration (GS) facility. In response, SJRenew provided updated documents including the Narrative, Pre-operational Testing Plan, and Testing and Monitoring plan, and a document summarizing their responses (SJR_Response_090822) to EPA on September 8, 2022. EPA's evaluation of how the updated document addresses its questions and requests for revisions and additional information are presented in *red italicized text* below.

The proposed operational procedures for SJR-I1 are summarized in the table below from EPA's Summary of Requirements template:

Parameter/Condition	Limitation or Permitted Value
Maximum Injection Pressure - Surface	Not provided
Maximum Injection Pressure - Bottomhole	Not provided
Annulus Pressure	Pressure at packer depth not provided
Annulus Pressure/Tubing Differential	Pressure at packer depth at average injection conditions not provided
Maximum CO ₂ Injection Rate (daily)	1,200 tons/day
Maximum CO ₂ Injection Rate (annual)	438,000 tons/year

Injection Pressure

The basis for the maximum injection pressure in relation to the Vedder Formation fracture pressure is described in the permit application Narrative. The total fracture gradient for the Vedder Formation (given in Appendix G of the Narrative) is 0.66 psi/ft. Based on this gradient calculation, the fracture pressure for the Vedder Formation at project depth of ~7,775 ft bgs is 5,132 psi (Narrative, pg. 30), which is equivalent to 353.8 bar. However, SJR did not provide an estimate of the surface or down-hole injection pressure.

Questions/Requests for the Applicant:

- Please provide an estimate of the surface and/or bottomhole injection pressures.*

The applicant responded that an injection pressure of 2,150 psia at the surface would be adequate to meet anticipated pressures in the injection zone. This information was added to Section 7.1 of the updated Narrative, which is supported by the Carbon Dioxide Phase Study included in Appendix B. Within the study, the surface injection pressure of 2,150 psia corresponds to the maximum downhole pressure of 3,865 psia as previously estimated. The updated Pre-operational Testing Plan describes the testing that will be conducted to determine surface and downhole injection pressures, consistent with the pre-operational testing objective. The response is acceptable.

Objectives for Pre-Operational Testing:

- *Determine maximum surface and downhole injection pressures based on pre-operational testing.*

Annulus Pressure and Annulus/Tubing Pressure Differential

The applicant does not discuss annulus pressure and annulus/tubing pressure differential in the description of injection well design in Section 3.3 of the Narrative.

Questions/Requests for the Applicant:

- *Please provide the annulus pressure and the annulus/tubing pressure differential.*

The applicant responded that the annulus pressure will be set at 50 psi for monitoring, with the annulus/tubing differential well to be determined by the injection pressure minus the annulus pressure. This was added to Section 3 of the updated Testing and Monitoring Plan and Section 7.1 of the updated Narrative. The response is acceptable.

Maximum CO₂ Injection Rate

SJR plans to inject 1,200 tons of carbon dioxide per day into well SJR-I1 for a period of 15 years, for a yearly rate of 438,000 tons/year and a total of 6.57 million tons (Narrative, pg. 29).

Questions/Requests for the Applicant:

- *Please describe standard operating procedures to ensure that the permitted maximum daily injection rate will not be exceeded.*

Section 7.1 of the updated Narrative discusses how the maximum injection rate will not be exceeded and references the continuous monitoring of injection rate and volume as outlined in the updated Testing and Monitoring Plan. Section 4 of the Testing and Monitoring Plan details the devices and frequencies for monitoring of these parameters. The response is acceptable.

- *Does SJR expect that the injection rate will be consistently 1,200 tons/day for the entire duration of the project, or are fluctuations in this rate anticipated? If fluctuations are anticipated, please describe.*

The applicant responded that a maximum daily injection volume of 1,500 tons per day will allow for some operational fluctuation; however, injection rates will be kept at an average of 1,200 tons per day, and an annual maximum of 438,000 tons per year. This information was added to Section 7.1 of the updated Narrative. The response is acceptable.

Shutdown Procedures

Section 6 of SJR's Emergency and Remedial Response Plan (ERR) states that a step-by-step shutdown procedure will be added to the document following the construction of the SJR-I1 well (ERR, pg. 7). Describing procedures for shutting down the well, either for routine workovers or in response to emergency events (other than those that warrant an immediate shutdown) will ensure that procedures are in place to shut down the well in a manner that will not damage the well and cause a mechanical integrity issue.

Questions/Requests for the Applicant:

- *Please describe the shutdown procedures that would be implemented as part of an emergency response, i.e., the rate of injection volume reduction over a specified number of days.*

The applicant responded that shutdown procedures would involve an immediate cessation of injection; however, under certain circumstances, a gradual cessation of injection may be appropriate. This would only be done in consultation with the UIC Program Director and within the parameters of the permit. This language has been added to the updated ERR plan, but it does not provide a specific reduction rate.

- *Please also describe routine well shutdown procedures (e.g., for well workovers), and if these would be the same as the gradual shutdown procedures requested above.*

The applicant responded that injection will be temporarily ceased during well workovers. This language has been added to Section 7.1 of the updated Narrative Report. The response is acceptable.

Follow-up Question/Request for the Applicant:

- *To facilitate responding to events that could necessitate a gradual shutdown, please provide an estimate of the rate at which injection operations would be reduced, i.e., injection volume reduction over a specified number of days.*

Automated Shutdown System

Section 6 of SJR's Emergency and Remedial Response Plan states that information on emergency shutoff controls and instrumentation will be added to the document following the construction of the SJR-I1 well (ERR, pg. 7).

Questions/Requests for the Applicant:

- *Please include standard operating procedures (including routine tests/checks and any failsafe mechanisms) to support the automated shutdown system when details about the system are provided.*

The applicant responded that details about the automated shutdown system will be provided when they are available. The response is acceptable pending receipt and review of these procedures.

Well Stimulation

SJR submitted a well stimulation program on January 7, 2022. The plan describes potential procedures for acid and fracture stimulation techniques, which SJR indicated that they may employ. This generic stimulation program meets the requirement at 40 CFR 146.88(a) that stimulation programs be approved by the EPA Director as part of the permit application and incorporated into the permit. EPA anticipates that, if SJR determines that stimulation is needed at a later date, they would provide updated procedures for EPA review and approval.