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Data Response Set 1 (Responses to Data Requests A1 to A8)

Submitted to
California Energy Commission

Prepared by
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With assistance from
Jacobs

Sutter Decarbonization Project
(97-AFC-02C)
October 29, 2024

Introduction

Attached are Sutter CCUS LLC's[1] (Applicant) responses to the California Energy Commission's (CEC) *Data Requests Set 1, A1 through A8* regarding the *Petition for Modification: Sutter Decarbonization Project* submitted for Sutter Energy Center (SEC) (97-AFC-02C). This submittal includes a response to Data Requests A1 through A8.

The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as presented *Data Requests Set 1, A1 through A8* and are keyed to the Data Request numbers.

[1] An indirect, wholly owned subsidiary of Calpine Corporation (Calpine).

Contents

Acronyms and Abbreviations

AFC	Application for Certification
CalGEM	California Department of Conservation, Geologic Energy Management Division
CEC	California Energy Commission
DR	Data Request
Project	Sutter Energy Center Decarbonization Capture Project

1. Noise and Vibration (DR A1-A3)

Background: Noise Data

The SEC petition to amend consists of a turbine upgrade, installation of a carbon capture facility, installation of a 16-mile pipeline, and construction of three injection wells into which carbon dioxide would be sequestered. Installation of the 16-mile pipeline and construction of the injection wells will be located approximately 10 miles southwest of the SEC.

The project owner states that the petition would not increase existing noise levels at SEC, that new equipment would meet the requirements of the existing Conditions of Certification, and a noise survey would be conducted after the project is constructed to validate noise levels at the nearest residences. However, it does not mention whether any human noise receptors exist near the planned locations of the injection wells.

Data Requests:

A1. Please identify any human receptors near the locations of the injection wells.

Response: As stated in Section 3.2 of the *Sutter Decarbonization Project – Land Use Analysis* (TN# 250246), no proposed well will be within 500 feet of an existing residence, as required by Sutter County Zoning Code Section 1500-05-030(T)(1). Locations of proposed injection wells are included in the Class VI application submitted to EPA Region IX in 2023. Final locations of the injection wells will be determined using core data obtained from the stratigraphic well to be drilled in Q4 of 2024 or Q1 of 2025. The stratigraphic test well will provide core data that will be used to validate the locations for placement of injection wells. Distances to human receptors will be determined and presented to the California Energy Commission (CEC) once the injection well locations have been finalized. Coordination with the California Department of Conservation, Geologic Energy Management Division (CalGEM) is ongoing.

A2. Please provide the daytime and nighttime ambient noise levels at those receptors.

Response: Calpine intends to conduct an ambient noise survey, upon finalization of the injection well locations, to document existing sound levels in the vicinity of noise sensitive uses proximate to proposed well locations and drilling activities. Sound level meters will satisfy the requirements for ANSI S1.4 Type I, precision, and will be factory/ traceably calibrated within the previous 24 months. Equipment will be field calibrated before and after each measurement series with a field calibrator that had been factory/ traceably calibrated within the previous 12 months. Measurements may be unattended or attended and will document Leq, L10, L50 and L90 sound levels over the measurement intervals. Concurrent wind speed measurements may be collected at one location or alternatively, regional weather data relied on. Monitoring locations and durations will be determined in coordination with CEC and property owners.

A3. Please provide the aggregate noise levels associated with the construction and operation of the injection wells.

Response: Noise levels from operation of the injection wells will be estimated after the design of the well injection system, which will occur after test data is analyzed from the stratigraphic test well.

2. Socioeconomics (DR A4-A5)

Background

Page 10 of the application states, "The Project will be built by entering into a Project Labor Agreement with the California State Building and Construction Trades" and "The Sutter Decarbonization Project will create 20-25 full-time, highly paid, clean energy jobs, resulting in positive economic benefits to the public." However, the number of construction workers required and the length of time to construct the Decarbonization Project is not provided.

Data Requests:

A4. What is the average and peak number of construction workers required for the project?

Response: The project is estimated to require approximately 1.5-million-man hours of represented labor. The maximum amount of workers on site during the construction period would be approximately 400, with average construction workforce of 200 workers.

A5. What is the approximate length of the construction period?

Response: The approximate length of the construction period is expected to take 36 months.

3. Soil and Water (DR A6-A8)

Background: Carbon Capture Facility Footprint

Although the artist's rendition (Figure 1) depicts the relative location of the carbon capture facility, the SEC petition to amend does not include the area of the facility's footprint.

Data Requests:

A6. Please provide a plan sheet detail of the carbon capture facility or estimate the surface area of the facility.

Response: The current area of the carbon capture facility is estimated to be 12 acres. The site is located adjacent to the existing SEC and within the fenced perimeter of the SEC and Greenleaf 2 emergency generation facility.

Background: Injection Zone Stratigraphy and Extent

The petition to amend states that the Kione and Starkey formations are proposed for carbon storage and that these formations are overlain by the Capay Formation and the Sacramento Shale, respectively. Stratigraphic columns of gas fields in the area indicate that the Capay Formation overlies the Starkey Formation, and the Sacramento Shale overlies the Kione Formation. In addition, it should be noted that the Starkey, Sacramento, and Kione formations are Upper Cretaceous in age, while the Capay Formation was deposited during the Eocene Epoch (DOGGR, 1982).

The petition to amend states that Class VI injection wells will be drilled to a depth of 3,100 feet. Based on a review of E-logs in the vicinity (CalGEM 2023), the Class VI wells would be completed in, and presumed to inject into, the Starkey Formation. This was confirmed during staff's July 20, 2023, site visit meeting with applicant. The petition mentions that the Kione Formation is used for saltwater injection 10 miles up-dip from the injection zone but does not mention the Starkey Formation.

Data Requests:

A7. Please revise the description of the injection and related formations using the recognized stratigraphic nomenclature. Also, use the recognized stratigraphic nomenclature in future documents.

Response: A revised description of the injection and related formations within the "Class VI Injection Wells at the CO2 Storage Complex" section of the Project Description (Section 1769(A)(1)(A)) is provided below:

> ***Class VI Injection Wells at the CO2 Storage Complex***
>
> *The geological storage complex for the Sutter Decarbonization Project is located approximately 10 miles southwest of the SEC. The storage complex Area of Interest ("AOI") is approximately 6-miles by 7-miles (42 square-miles or sq-mi). The identified storage complex is composed of the Early Tertiary Starkey sandstones of the Sacramento Basin. This is overlain by the Capay Shales, which is widely acknowledged as a regional seal and forms the confining unit for the proposed injection complex. The CO2 plume size inside the AOI is based on the maximum modeled injection volumes for three wells in the Starkey sandstone as described below over the project lifetime (30 years injection*

followed by 50 years post injection) and for a vertically integrated mass per unit area to determine the plume footprint within the AOI.

Please also refer to the revised text within the Affected Environment section of the Paleontology Memo (page 4) (Jacobs 2023):

The surficial geological units mapped in and around the project footprint include the following (see Figure PALEO-1):

- *Qa - Levee and channel deposits. Holocene age deposits of active stream channels and their natural levees and alluvial fans.*
- *Qb - Basin deposits. Holocene age fine-grained silt and clay deposits in flood basins between modern watercourses. This unit underlies the project site, the pipeline route, and the injection well area.*
- *Qm - Modesto Formation. Late Pleistocene alluvial terraces and fans. This unit occurs near the project site at the surface and underlies Qa and Qb at some unknown depth.*

While the carbon capture facility and the pipeline would likely be within the geological units listed above, the injection wells would extend below ground into Capay Shale and into the Early Tertiary Starkey sandstones of the Sacramento Basin.

A8. Assuming the Starkey Formation is continuous as suggested by local E-Logs, please describe how injected carbon dioxide would be contained laterally.

Response:

The Environmental Protection Agency's Underground Injection Control (UIC) program regulates the construction and operation of injection wells used for geologic sequestration of carbon dioxide (CO2). For geologic sequestration of carbon, the focus is not on lateral containment of injected carbon dioxide per se, but rather on: (1) ensuring that injected CO2 does not leak upward; (2) ensuring that the injection formation can provide long-term storage of the CO2; and (3) ensuring that underground sources of drinking water (USDW) are protected.[2]

To address the three issues identified above, numerical simulation of CO2 injection was conducted of the proposed subsurface carbon storage site. A subsurface carbon storage complex is a "geologic storage site that is targeted to safely and permanently store injected CO2 underground. It includes a storage formation with at least one, or usually multiple, regionally continuous sealing formations called caprocks or seals (NETL, 2023)." Numerical simulation of CO2 injection into deep geologic reservoirs requires the modeling of complex, coupled hydrologic, chemical, and thermal processes, including multi-fluid flow and transport, partitioning of CO2 into the aqueous phase, and chemical interactions with aqueous fluids and rock minerals. For the Sutter Decarbonization Project, the Starkey Storage Complex consists of the Starkey (injection zone) overlain by the Capay Shale (upper confining zone) and underlain by the Winters Formation (basal confining zone). INTERA Incorporated developed a model for the Starkey Storage Complex which used as input a geocellular model built in Petrel and was run using Subsurface Transport Over Multiple Phases (STOMP) dynamic reservoir simulation software with the CO2 module (STOMP-CO2) (White et al. 2012; White and

[2] https://www.epa.gov/system/files/documents/2023-04/EPA%20Pamphlet_How%20Class%20VI%20Regulations%20Ensure%20Groundwater%20Protection.pdf

Oostrom 2006; White and Oostrom 2000). STOMP-CO2 was verified against other codes used for simulation of geologic disposal of CO2 as part of the GeoSeq code intercomparison study (Pruess et al. 2002). For this project, the parallel implementation of STOMP-CO2 (called STOMPX-CO2) was used.

The model simulated the injection of CO2 through three lateral injection wells CCS1, CCS2, and CCS3, using a fully coupled well model (White et al., 2013). An injection period of 12 years was simulated followed by a 50-year post-injection period, for a total simulation time of 62 years. An injection rate of 1.0 million tonnes per year was initially specified for each well; however, the formation properties resulted in a pressure-controlled injection that was limited by the maximum injection pressure. Therefore, the injection rate quickly dropped to a rate that can be accommodated by the formation properties while staying below the specified maximum injection pressure, and hence, was not constant for the operational period.

Figure 1 shows the total mass of injected CO2 over time, and the proportion of that which is in the supercritical gas phase and the dissolved phase. Note that the trapped gas shown in the figure exists in the CO2-rich phase and is therefore included in the mass of CO2 in the CO2-rich phase shown in the plot. Most of the CO2 mass occurs in the CO2-rich (or separate) phase, with about 25 percent occurring in the dissolved phase at the end of the simulation period. Note that once injection ceases, residual trapping begins to take place, resulting in about 7% of the total CO2 mass being immobile at the end of 62 years. The total mass injected by each well is shown in Figure 2.

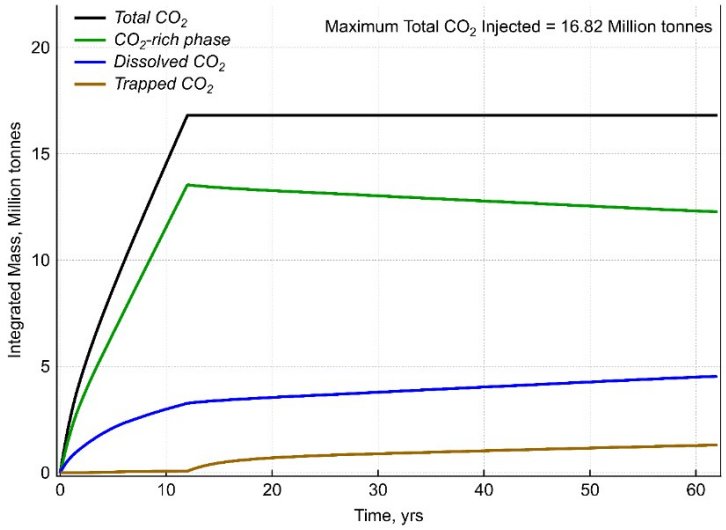

Figure 1. Total integrated mass injected over three lateral injection wells screened in the Starkey Clean Sand.

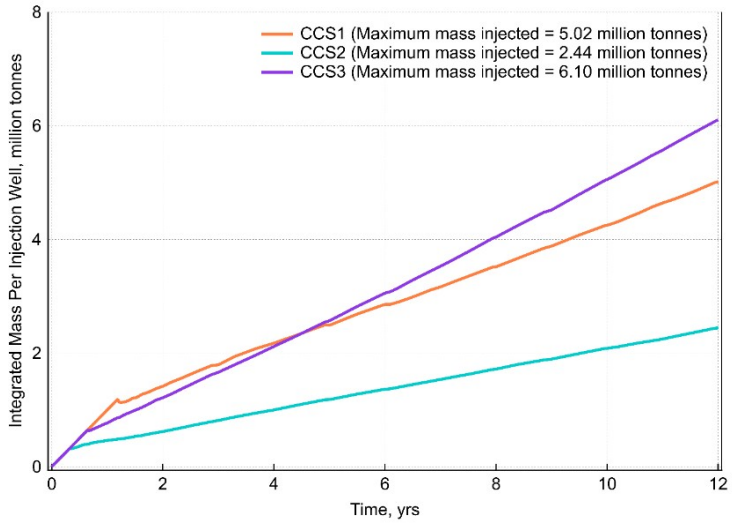

Figure 2. Total injected mass by each lateral injection well screened in the Starkey Clean Sand.

Because the threshold calculation produced a negative value whether using Method 1 for under-pressured reservoirs or Method 2 for over-pressured reservoir, the Area of Review (AoR) proposed for the Sutter Decarbonization Project is risk-based rather than pressure-based. The salinity of the *in-situ* storage reservoir brine is estimated to be 14,000 ppm. While this is considered highly saline (> 10,000 ppm), it is far less saline than ocean water (35,000 ppm) (USGS, 2023). The National Risk Assessment Partnership's (NRAP) open-source integrated assessment model (OpenIAM) tool was used to assess the potential leakage rate of CO2 and brine from the injection reservoir into the lowermost USDW. This method demonstrates that there is little risk of mobilizing CO2 or brine into a USDW due to pressure increases in the storage formation.

The lateral extent of the CO2 plume was defined by the vertically integrated mass of CO2 per area (Zhang, 2015). To ensure that Sutter Decarbonization Project CO2 injection activities protect groundwater Resources: (1) the AoR was delineated by the CO2 plume at the end of the injection period with a doubling in perimeter area to account for plume expansion during the post-injection period (Figure 3); (2) a comprehensive groundwater monitoring is planned; and (3) injection wells will be constructed and operated in accordance with the EPA's well construction requirements to help prevent CO2 leakage.

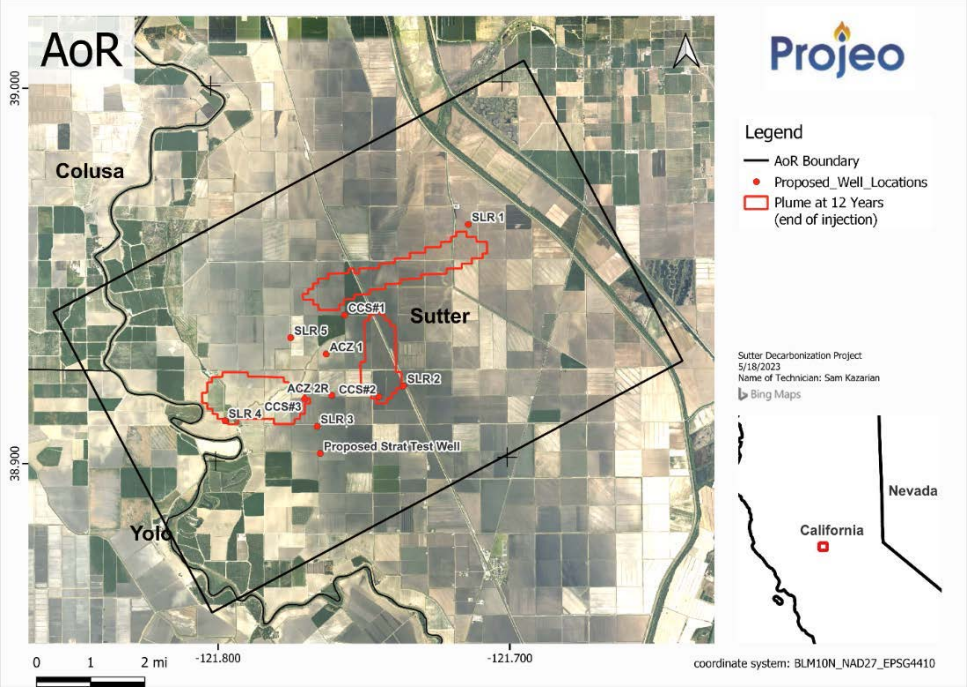

Figure 3. Sutter Decarbonization Project delineated Area of Review (black line), CO2 plumes after twelve years of injection (red line), and proposed well locations (red circles). The coordinates of the AoR vertices in (X, Y) are {(- 121.6923758, 39.00561305), (-121.8550457, 38.94027604), (-121.8019166, 38.85971502), (-121.6393845, 38.92498152)}