



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

75 Hawthorne Street
San Francisco, CA 94105-3901

May 18, 2018

Melvin D. Murphy
Authorized Representative
Panoche Energy Center
43883 West Panoche Road
Firebaugh, California 93622

**RE: Underground Injection Control (UIC) Permit Renewal Application
Class 1 Non-Hazardous (NH) Permit No. R9UIC-CA1-FY17-2R
Technical Review**

Dear Mr. Murphy,

EPA is currently conducting technical review of the subject permit application dated October 20, 2017. While EPA deemed your application administratively complete, our technical review has identified additional information that we require to supplement certain sections of the application. The technical details and records, described in the Enclosure, are necessary for EPA to continue our technical review of the application.

Please provide hard copies of the requested information for us to insert into our three hard copies of your original application, and submit an updated, complete electronic version on CD. We also request that you share copies of the updated CD with the agencies copied on this letter.

If you have any questions or need to discuss this further, please do not hesitate to call George Robin of my staff at 415-972-3532 or me at 415-972-3971.

Sincerely,

A handwritten signature in blue ink, appearing to read "D. Albright".

David Albright, Manager
Drinking Water Protection Section

Enclosure

cc: Alan Walker, CA DOGGR
Bill Bartling, CA DOGGR, Inland District
Clay Rodgers, Central Valley Regional Water Quality Control Board

Enclosure

Attachment A, Area of Review (AOR) Method

The application states that the Panoche Formation is encountered at a depth of approximately 7,100 feet at PEC.

- *What is the reference point for the depth measurement (i.e., BGS, KB, TVD)?*

The application states that “An evaluation of the wastewater injection history at PEC was conducted to project a conservative baseline annual injection volume for the period between July 2017 and June 2018 (Figure A-1)” and “... 90 million gallons (MGal) of wastewater is considered a reasonable upper bound projection of the injection amount for the period of July 2017 to June 2018 under the condition of no EWS.” However, in Figure A-1, the yellow mark “projected amount of wastewater generated without the enhanced wastewater system” is at about 48 million gallons.

- *Please explain this discrepancy and how those numbers are being used for projections.*

The application states that the efficiency of the EWS is about 70% and refers to the Haley & Aldrich, 2016 study. The application relies on the 70% efficiency of the EWS in the calculation of the total volume of future wastewater injection for the next 10 years.

- *Please provide a copy of the Haley & Aldrich, 2016 study.*
- *Please explain the basis for selecting 70% efficiency for the EWS. If the EWS does not fully function, a higher volume will need to be injected into the proposed injection wells. Please explain if and how this was considered in the ZEI calculation.*

The application states that “The modeling procedure and parameters used were the same as those used for the 2016 annual AOR and ZEI evaluation (Haley & Aldrich, 2017).” No information was provided on the model parameters, model assumptions, and the model structure.

- *Please provide a copy of the Haley & Aldrich, 2017 study and fully describe the model parameters, model assumptions, and the model structure.*
- *What is the rationale for selecting a 25 psi pressure increase (6% increase in pressure difference) for determining the ZEI?*
- *It is not clear how, with continuous injection into the formation, the pressure increase would be smaller at the end of 2027 than 2016. Please provide evidence to support this.*
- *On page 2-1, second full paragraph, the application references “gradual dissipation of increased pressure in the Panoche Formation due to past injection.” The dissipation rate*

is expected to be quite slow in a zone with such low permeability. Please clarify if and how the dissipation was considered in the model during the injection period.

- *Please clarify if and how the two proposed injection wells IW5 and IW6 were considered in the modeling evaluation.*

Attachment B, Maps of Wells and Area of Review

The application provided information on the water supply wells located within 1-mile of the PEC in Table B-1, and not throughout the 2.75-mile AOR, as required at 40 CFR 146.14(a)(2). All of the wells shown in Table B-1 were active, although the table indicates that information such as screened interval, total well depth, groundwater basin were not available for many of these wells.

- *Please include this information on all water supply wells within the AOR, per 40 CFR 146.14(a)(2).*
- *Please identify wells, springs, other surface water bodies, and drinking water wells located within the AOR rather than one quarter mile of the facility property boundary per 40 CFR 146.14(a)(2).*

The application states that “The closest oil and gas well is the England 1-36 which is 1.25 miles away.” Figure B-1 shows the closest plugged oil and gas wells are England 1-31 and Silver Creek 18-1.

- *Are there any oil and gas wells that are not plugged within the AOR?*
- *Please clarify if the England 1-36 well exists, otherwise please revise the text.*

Attachment C, Corrective Action Plan and Well Data

Exhibit C-1 is a tabulation of data on wells located within a radius of approximately three miles from the PEC facility that were drilled to a depth that penetrated the current injection zone or to a depth just above the current injection zone.

The application cited the DOGGR “Onshore Well Regulations” and stated that “In general, cement plugs will be placed across specified intervals to protect oil and gas zones ... Mud fluid having the proper weight and consistency to prevent movement of other fluids into the well bore shall be placed across all intervals not plugged with cement...” Based on this, the application indicated that all the wells listed in Table C-1 were abandoned properly. However, 200-foot cement plugs at the top of the injection zone and at the base of USDWs, and plugs at the surface casing shoe and the surface may not be adequate nor proper for addressing the pressure influence of PEC’s injection wells for any abandoned well within the AOR that penetrates the injection zone. Therefore, in the context of pressure increase from Class 1 NH disposal, the wells listed in Exhibit C-1 may not have been abandoned properly based on the information provided in the “plugged interval” column.

- *Please amend Table C-1 and include information about the perforated or screened depths.*

- *The URLs provided in Table C-1 are not working. Please include the record of plugging and/or completion for these wells to demonstrate that corrective action is not needed. Please include schematic diagrams showing stratigraphy, plugging and construction details, base depth of the USDW, formation names and depths, and perforated or screened depths.*
- *What does the Derrick Floor (DF), presented on the footnote of Table C-1, represent?*

Attachment D, Maps and Cross Sections of USDWs

The application, on page 5-3, indicated that "... the depth to base of fresh water (defined as less than 2,000 mg/L TDS), and critically, how the base of the lowermost USDW was determined, has been presented in URS's IW1 Well Completion Report (URS, 2009)." The application states that the study showed that aquifers below the undifferentiated marine sandstones and shales that underlie the Oro Loma Formation were not considered USDWs based on the calculated salinity concentration that was estimated using resistivity values. No calculations or other data are provided to support the statement that there is no other formation with TDS below 10,000 mg/L below the undifferentiated marine sandstones and shales unit.

- *Please provide a copy of the URS, 2009 study and copies of the logs used to calculate salinities.*
- *Please provide any measured TDS data available from aquifers below the undifferentiated marine sandstones and shales unit as well as the Panoche Formation.*

Figure D-3 shows two cross sections depicting the lateral and vertical extent of the Corcoran clay. The cross sections only present information above the Kreyenhagen Shale Formation.

- *Please provide cross sections that show the vertical and lateral limits of all USDWs relative to the injection formation, and include the Panoche Formation, proposed injection formation, in the cross sections.*

Attachment F, Maps and Cross Sections of Geologic Structure of Area

The application indicates that Figure F-3 shows the locations of two cross section lines, cross section B-B' shown in Figure F-4 and cross section A-A' documented in the AMEC, 2012 report. However, Figure F-4 shows a cross section labeled A-A' not B-B' and it appears that this cross section shows a different location than the location presented by cross section line A-A' in Figure F-3. No structural and isopach contour maps and data were provided to support the thickness of the injection formation and the upper and lower confining layers.

- *Please provide a copy of the AMEC, 2012 report.*
- *Please provide structural cross section A-A', A'-A'' and B-B' shown in Figure F-3 and present any other structural cross sections available for the area within the AOR.*
- *Please provide structural and isopach contour maps for the injection formation, and the upper and lower confining layers.*

- *Please provide the approximate depths of the top and bottom of the confining layers and injection interval and any data available to support determination of depth, thickness, lithology, porosity, permeability of these formations.*

Attachment H, Operating Data

In Table H-1 of the application, average and maximum injection rate, daily volume, and injection pressure data were presented for the last four quarters during which the EWS was in operation, and there was a significant decrease in wastewater injection. Also, on page 7-1, fourth full paragraph, the application provided the maximum historic recorded daily injection volume for each of the four wells and indicated that injection wells can operate “at least at these daily injection volumes.” So, it is not clear if the injection rate and volume could exceed these values or if the application limits the injection rate and volume to those values.

- *Please provide the proposed average and maximum injection rate, daily volume and pressure for each well; providing this information in a table is preferred to facilitate our review.*

Attachment I, Formation Testing Program

The application indicated that numerous dual (we understand to mean “decay”) temperature profiles have been conducted as part of external mechanical integrity tests (MITs) and cited the USEPA reports for summary of the figures.

- *Please provide copies of the most recent, representative log results.*

Under “Step-Rate Testing,” the application indicated that a step rate test (SRT) was performed on April 6, 2009 in well IW1 and the results showed a fracture gradient of 0.972 psi/ft, which was also used as the fracture pressure gradient for other wells. The application also stated that a subsequent fracture simulation conducted in well IW3 showed a higher MAIP and cited the Haley & Aldrich, 2013 study.

- *Please provide copies of the IW1 SRT report (URS 2009a) and IW3 Fracture Stimulation Report (Haley & Aldrich, 2013).*

Under “Other Physical, Chemical and Radiological ...,” the application provided porosity and permeability values estimated from core samples collected from the injection zone. However, no core data was provided.

- *Please provide data such as cores, drill stem test, well logs or other well-specific test results that support the determination of depth, thickness, lithology, porosity, and permeability, elastic properties, storage coefficient of the injection zone.*
- *Please provide information on the hydrogeology of the confining zones, including thickness, age, lithology/mineralogy, structure, and hydrologic parameters including permeability, porosity, oil/water saturation, compressibility, and formation fracture pressure.*

The application indicated that the results of analysis of formation water samples collected from well IW1 and IW2 showed TDS concentrations ranged from 34,800 to 112,000 mg/L indicating that the injection zone is not a USDW and cited the URS, 2009 study. However, the additional fluid analysis during deepening of IW3 and IW4 show lower TDS concentration ranging from 11,000 to 12,000 mg/L, and cited AMEC, 2012c for more details. The application stated that the injection of relatively fresh wastewater in recent years lowered the TDS.

- *Please provide a copy of the URS, 2009 and AMEC, 2012c report.*
- *Please provide the salinity calculations from electric and porosity logs in the four injection wells.*

Attachment J, Stimulation Program

The proposed general fracture stimulation program for Wells IW5 and IW6 is acceptable; however, we will require submittal of a detailed procedure to EPA for review and approval before allowing notice 30 days prior to scheduling the stimulation work.

- *Please provide details that especially cite where the proposed stimulation program for Wells IW5 and IW6 differs from the IW3 Fracture Stimulation.*

Attachment K, Injection Procedures

Under “Enhanced Wastewater System,” the application stated that “The lower-than-anticipated performance of the injection system, as compared to the original design requirements for disposal of approximately 500 gallons per minute (gpm), presented a significant challenge to the operation of the facility prior to 2015.”

- *Please describe the challenges that result in low performance of the injection system.*

Attachment L, Construction Procedures

The application stated that “All long string casings are cemented to surface except IW2, which has top of cement at approximately 4,826 feet.”

- *Please provide evidence i.e., MIT results (especially from Temperature Logs) that this configuration is protective of the USDW and there is no upward fluid movement out of the Domengine Formation or any other inter-formational flow.*

The application states that “The permit modification request submitted by PEC on November 6, 2012 was for fracture stimulation of both IW3 and IW4 injection wells (Haley & Aldrich, 2012).” The application indicated that the fracture stimulation work was performed on May 4 and 5, 2013 and temperature, radioactive tracer (RAT), and continuous flowmeter surveys were performed prior to and after fracture stimulation and cited the Haley & Aldrich, 2013b and Haley & Aldrich, 2013c studies.

- *Please provide a copy of the Haley & Aldrich, 2012; Haley & Aldrich, 2013b; and Haley & Aldrich, 2013c studies.*

Attachment M, Construction Details

- *Please clarify that plan B, injection into the Upper Cretaceous age D1 and D2 sand members of the Panoche Formation below the Marca and Tierra Loma Shale members of the Moreno Formation, is the same for all six wells?*

Attachment P, Monitoring Program

Under “Proposed Falloff Testing of IW2 Procedures,” the application states that “If possible, shut in all three of the other plant wells using normal plant procedures. If not possible, then monitor other site wells for pressure interference using plant’s pressure monitoring system while conducting reservoir testing at IW2.” It is recommended that all offset wells be shut-in prior the test. However, if shutting in offset wells is not feasible, a constant injection rate needs to be maintained in offset wells prior to and during the test.

- *Please amend the third bullet to state that a constant injection rate will be maintained prior to and during the test as well.*

Attachment Q, Plugging and Abandonment Plan

- *Please note we will require in lieu of cement plugs separated by formulated plugging mud, that the entire hole be filled with cement extending from the injection zone to surface. Additionally, the plugging procedures for Well IW2 must include cementing the uncemented portion outside of the 7-5/8 inch casing above the plugged DV tool at 4,826 ft. and performing cement bond evaluation logging.*

Under “Plug and Abandonment Plans and Cost Estimates,” the applicant indicated that USEPA form 7520-14 (Plugging and Abandonment Plan) will be prepared and submitted when the wells are ready for abandonment.

- *Please provide the completed P&A forms. If the plugging plans change, they would be revised and re-submitted before the wells are plugged.*