

PANOCHÉ ENERGY CENTER – FIREBAUGH, CA
UIC PERMIT RENEWAL APPLICATION (DATED OCTOBER 20, 2017)
USEPA REGION 9 COMMENT LETTER (DATED MAY 18, 2018)
SUMMARY OF RESPONSES AND QUESTIONS

July 12, 2018

1.0 Background Information

This document summarizes the general responses and questions prepared by Panoche Energy Center, LLC (PEC) in response to comments dated May 18, 2018 from USEPA Region 9 regarding PEC's October 20, 2017 underground injection control (UIC) permit renewal application for existing Class I (nonhazardous) wastewater injection wells IW-1, 2, 3, 4, and permitted (but not drilled) wells IW-5 and 6. The respective comments provided by the USEPA are re-stated below in bold font for context, and responses and/or related questions from PEC are summarized below in italic font next to the open (o) bullet points following each USEPA comment. This document is intended as the next step in the process of helping move PEC's permit renewal application toward final approval. Follow-up telephone calls, e-mails, and/or meetings with the USEPA may be needed to further advance this process. It is understood by PEC that all final responses to comments must be documented in a revised permit renewal application that will be provided to the USEPA.

2.0 USEPA Comments with PEC's Responses and Questions

Attachment A – Comment 1: 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 Panoche Fm. depth measurements?**
 - *PEC will provide clarification on page 2-1 of the permit renewal application.*

Attachment A – Comment 2: 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.

- **Explain the discrepancy and how those numbers are being used for projections.**
 - *PEC will clarify the text in Section 2.3 and Figure A-1.*

Attachment A – Comment 3: 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.**
 - *PEC will provide this study as an appendix item in the revised permit renewal application.*
- **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.**
 - *PEC will explain and justify the basis for the 70% reduction for the EWS.*
 - *PEC will clarify how the selected volume was used in the ZEI calculation.*

Attachment A – Comment 4: The application states that “the modeling procedure and parameters were the same as those used for the 2016 annual AOR and ZEI evaluation (H&A, 2017).” No information was provided for model parameters, assumptions, and structure of model.

- **Provide a copy of the H&A, 2017 study and fully describe the model parameters, model assumptions, and model structure.**
 - *PEC will provide the requested reference (H&A, 2017) and revise the permit renewal application text to include the requested discussion.*
- **What is the rationale for selecting a 25 psi pressure increase (6% increase in pressure) for determining the ZEI?**
 - *Given that the native pressure head of the Panoche Formation reservoir was approximately 570 feet above ground level and nearly 2,500 feet above the base of the USDW, a conventional ZEI evaluation is not possible at the PEC site. In addition, the native pressure head in the shallow confined aquifer used for on-site water supply was at approximately 400 feet below ground level, resulting in nearly 1,000 feet of differential compared to the Panoche Formation. This, combined with the significantly lower TDS in the shallow aquifer system compared to the Panoche Formation and approximately 3,000 feet of net shale section between the top of the Panoche Formation and base of the USDW, demonstrates excellent hydrogeological confinement of the Panoche Formation.*

Because of this, the original permit application for the PEC wells and subsequent annual updates were approved based on a pressure increase model where 25 psi was determined to be the minimum reservoir pressure increase limit that would be attributed to PEC's injection operations. This became the default pressure envelope within which an AOR evaluation should be completed. After the issuance of the permit, the fall-off tests conducted for compliance of the original permit have consistently demonstrated the integrity of the injection wells and shown that an injection pressure of approximately 2,000 psi does not create fractures in the vicinity of the injection wells. These fall-off testing results further support that the formation can sustain a pressure increase significantly higher than 25 psi. On this basis, PEC proposes to maintain this approved ZEI and AOR approach moving forward.

- **It is not clear how, with continuous injection into the formation, the modeled pressure increase is smaller in 2027 than in 2016. Pleas ed provide evidence to support this.**
 - *PEC will clarify that utilization of the EWS decreases the overall volume of wastewater that will need to be injected and that injection is currently not continuous.*

- **On page 2-2, second full paragraph, the application references “gradual dissipation of increased pressure in the Panoche Fm. 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.**
 - *PEC will provide clarification.*

- **Clarify if and how the two proposed wells IW5 and IW6 were considered in the modeling evaluation.**
 - *PEC will provide clarification.*

Attachment B – Comment 1: The application provided information on water supply wells located within 1-mile of the facility 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.

- **Include this information on all water supply wells within the AOR, per 40 CFR 146.14(a)(2)**

- *It appears that PEC has provided this information on Figure B-1. PEC needs further clarification from the USEPA regarding this comment and the requirement to provide tabulated information for water wells that do not penetrate the injection zone (see 40 CFR 146.14(a)(3) for clarification).*
- **Identify wells, springs and other surface water bodies, and drinking water wells located within the AOR rather than within ¼-mile of the facility 40 CFR 146.14(a)(2).**
 - *PEC will add this information (if necessary to Figure B.1).*

Attachment B – Comment 2: The application states “the closest oil and gas well is the England 1-36 which is 1.25 miles away. Figure B-1 shows the closest well as the England 1-31 and Silver Creek 18-1.

- **Are there any oil and gas wells that are not plugged within the AOR.**
 - *PEC will correct Figure B-1.*
- **Clarify if the England 1-36 well exists, otherwise revise the text.**
 - *PEC will confirm this and clarify as needed.*

Attachment C – Comment 1: 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 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.**
 - *PEC will review the available records and provide the information in the table.*

- The URLs provided in Table C-1 do not work. Please provide the plugging and completion records for these wells to demonstrate that corrective action is not needed. Please include schematic diagrams showing stratigraphy, plugging and construction details, base of USDW, formation names and depths, and perforated or screened depths.
 - *PEC will provide this information as required by the Federal Regulations or any written guidance that is available from Region 9.*

- **What does the derrick floor (DF) presented in the footnote of Table C-1 represent.**
 - *The DF refers to the drilling depth measurement datum corresponding to the drilling rig derrick floor, which is essentially equivalent to the kelly bushing (KB) level.*

Attachment D – Comment 1: 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.**
 - *PEC will provide the necessary documentation for review as an appendix in the revised permit renewal application.*

- **Provide any measured TDS data available from aquifers below the undifferentiated marine sandstones and shales unit as well as the Panoche Formation.**
 - *PEC will identify and provide any available information.*

Attachment D – Comment 2: 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.**
 - *PEC will provide the requested cross-sections and information.*

Attachment F – Comment 1: 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.

- **Provide a copy of the AMEC, 2012 report.**
 - *PEC will provide the requested reference (AMEC, 2012).*
- **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.**
 - *PEC will clarify the cross-sections as required.*
- **Provide structure and isopach contour maps for the injection formation and upper and lower confining layers.**
 - *PEC will provide the required maps.*
- **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.**
 - *PEC will review the available information and expand the discussion of these intervals in the application text.*

Attachment H – Comment 1: 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.

- 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.
 - *PEC needs to discuss this comment in the context of the current permit, which appears to be pressure-limited, and not rate and/or volume-limited.*

Attachment I – Comment 1: 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.

- Provide copies of the most recent, representative log results.
 - *PEC will provide the requested logs in the revised permit renewal application. Please note that providing logs, reports, and other documentation would be made more efficient if a single computer disk could be added to the permit renewal application as a supplemental appendix that includes digital copies (in PDF file format) of all requested information.*

Attachment I – Comment 2: 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.

- Provide copies of the IW1 SRT report (URS, 2009) and IW3 Fracture Stimulation Report (H&A, 2013)
 - *PEC will provide the requested reports in the revised permit renewal application.*

Attachment I – Comment 3: 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.

- 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.
 - *PEC will provide the available information requested in the revised permit renewal application.*

- Provide information on the hydrogeology of the confining zones, including thickness, age, lithology/mineralogy, structure, and hydrological parameters including permeability, porosity, oil/water saturation, compressibility, and formation fracture pressure.
 - *PEC will provide any available information requested in the revised permit renewal application.*

Attachment I – Comment 4: 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.

- Provide a copy of the URS, 2009 and AMEC, 2012c report.
 - *PEC will provide the requested reports.*
- Provide the salinity calculations from electric and porosity logs in the four injection wells.
 - *PEC will provide any available information concerning salinity calculations.*

Attachment J – Comment 1: 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.

- Provide details that especially cite where the proposed stimulation program for wells IW5 and IW6 differs from the IW3 fracture stimulation.
 - *PEC will provide the requested discussion.*

Attachment K – Comment 1: 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."

- Describe the challenges that result in low performance of the injection system.
 - *PEC will provide the requested discussion.*

Attachment L – Comment 1: The application stated that "All long string casings are cemented to surface except IW2, which has top of cement at approximately 4,826 feet."

- 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.
 - *PEC will provide the requested log(s).*

Attachment L – Comment 2: 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.

- Provide a copy of the H&A, 2012, H&A, 2013b, and H&A, 2013c studies.
 - *PEC will provide the requested reports.*

Attachment M – Comment 1:

- 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 in all six wells.
 - *PEC will provide the requested discussion.*

Attachment P – Comment 1: 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.
 - *PEC will provide the requested additional discussion.*

Attachment Q – Comment 1:

- **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.**
 - *PEC needs additional clarification on this request. CFR §146.10 does not state that this is required. Additionally, in the previous application by URS (2006) this approach was acceptable. Also, discreet plugs are acceptable in other USEPA regions.*

Attachment Q – Comment 2: 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 resubmitted before the wells are plugged.**
 - *PEC will provide the requested forms.*