

Peer Review Plan

Paradox Valley Unit Six Month Injection Test Plan

Date: June 9, 2020

Originating offices: Western Colorado Area Office, Upper Colorado Region, Bureau of Reclamation, 445 W Gunnison Ave, Grand Junction, CO 81501

Reclamation roles:

Delegated manager: Reece Carpenter, Chief, Northern Facilities Maintenance Group, Western Colorado Area Office, Upper Colorado Region

Peer Review Lead: Andy Nicholas, Facility Operations Specialist, Paradox Valley Unit Western Colorado Area Office, Upper Colorado Region

Subject and Purpose: Reclamation is responsible for a portion of the Colorado River Basin Salinity Control Program. One project in the program is the Paradox Valley Unit. The unit intercepts shallow saline groundwater prior to entering the Dolores River, a tributary of the Colorado River, and disposes the brine in a 16,000' deep injection well. The well has been operated nearly continuously since 1996, with induced seismicity as a byproduct of the process.

An M 4.5 earthquake occurred in March 2019, about 1.6 km from the well, and was the largest induced earthquake to date. Following the Standard Operating Procedure for the well, the project was shut down to assess damage to the facility, analyze the earthquake and its aftershocks, and to allow the pressures in the injection zone to subside. No damage was found, and the well remained shut down for 14 months while studies progressed. These studies indicated that: (1) the earthquake was similar to previous induced earthquakes in the near-well area, (2) pressures at the location of the earthquake had decreased substantially during the shut-in, and (3) if operations resumed at a reduced injection rate, then pressures in the near-well area could be maintained below those that occurred just prior to the earthquake, for a period of at least several years.

Reclamation is assessing the long-term viability of the injection well through ongoing and planned studies. However, because of the length of the shut-in (the longest to date), a key concern is whether the injection well could continue to operate as before if it were to be restarted for long-term operations. Critical unanswered questions include: (1) the potential for plugging, damage or other impairment of the injection tubing and

perforations; (2) the potential for near-well flow impairment due to precipitation, fracture closure, or other effects; (3) whether the pressure-flow response has changed; and, (4) whether seismicity response in the near-well area has changed significantly.

These questions are best answered by a limited-duration test of the injection well; a period of 6 months was chosen as the minimum term that would provide useful data. The purpose of the six-month injection test is to determine the injection well's ability to continue to accept fluid at a reduced injection rate after being shut in for 14 months, the current pressure response of the well to injection, and the near well (<5 km) seismic response to resumed injection at the lower rate. The test plan is intended to provide operational and monitoring guidelines during the test period.

Impact of Dissemination: The Paradox Valley Unit Six Month Injection Test Plan is not considered influential or highly influential scientific information as defined by Office of Management and Budget Final Information Quality Bulletin for Peer Review (70 FR 2664-2677) and the Reclamation Manual Policy CMP P14 Peer Review of Scientific Information and Assessments. The nexus of this determination is that this document may provide a clearer understanding of the concerns associated with this topic, however there is no known decision or policy that will be affected by its dissemination. This peer review is considered discretionary based upon Reclamation Manual Policy CMP P14.

Peer Review Scope: The peer reviewer will consider the proposed observational parameters and corresponding responses established in the test plan. The Reviewer is expected to focus on the following questions:

1. Are the parameters listed in the test plan (wellhead and annulus pressures, characteristics of near-well seismicity) reasonable to monitor, considering the history of injection operations at PVU, and the goals of the testing?
2. Are there any other parameters, not identified in the test plan, that should be monitored for evaluating the injectivity of the well and associated seismic response?
3. Are the expected parameter responses listed in the test plan reasonable for the specified time frames?
4. Is the length of the proposed injection test adequate for evaluating any potential changes in near-borehole conditions that may have occurred since injection was suspended in March 2019?

Timing of Review: The review period is expected to be June 15 to July 15, 2020. The final Peer Review Report is expected to be available on the U.S. Bureau of Reclamation Peer Review public website (<http://www.usbr.gov/main/qoi/peeragenda.html>) by August 15, 2020.

Methodology of Review: Review will be conducted by individuals. The identities of the reviewers will be disclosed in the final Peer Review Report. Review findings/comments will be attributed to the individual reviewer.

Number of Peer Reviewers: It is anticipated that 1 to 2 peer reviewers will be utilized.

Reviewer Selection Process: Peer reviewers will have professional experience in the field of injection well operations, petroleum engineering, geophysics, pressure and flow modeling, deep well fluid disposal, and injection well testing.

Delivery of Findings: The Peer reviewer should submit a digital copy of peer review comments that address the supplied reviewer questions. Comments should be submitted to the peer review lead.

Response to Peer Review: At the conclusion of receiving peer review comments, the Peer Review Lead will submit a final Peer Review Report to the U.S. Bureau of Reclamation Peer Review public website (<http://www.usbr.gov/main/qoi/peeragenda.html>) which will summarize the findings of the peer review and list the comments provided by the reviewers, as well as Reclamation's response to the comments.

Federal Register Notice: Federal Register notices will not be provided announcing the formation of a peer review team and completion of the final report.

Applicability of the Federal Advisory Committee Act (FACA): This peer review is not subject to the Federal Advisory Committee Act (FACA) because the review does not involve open meetings or committee chartering and reviewers are being asked to provide individual reviews on the subject matter. Reclamation is not seeking consensus advice from the reviewers as a group.

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