FACT SHEET
U.S. Environmental Protection Agency, Region 9 Draft Class V Experimental Underground Injection Control Permit Number R9UIC-CA5-FY13-1
Pacific Gas and Electric Company

Location:
San Joaquin County, California
King Island Gas Field, Pacific Gas and Electric Company Facilities
Well Site - Section 27, Township 3 North, Range 5 East, Northwest ¼

Permittee Contact:
Mr. Mike Medeiros
Manager, Renewable Energy Development
Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94105
Telephone: (415) 973-6270
Email: MJML@pge.com

Regulatory Contact:
Michele Dermer, Environmental Engineer
U.S. Environmental Protection Agency, Region 9
Ground Water Office, Mail Code WTR-9
75 Hawthorne Street
San Francisco, CA 94105-3901
Telephone: (415) 972-3417
Fax: (415) 972-3545 (include name and mail code from above)
Email: dermer.michele@epa.gov

I. Purpose of the Fact Sheet

Pursuant to the Underground Injection Control (UIC) regulations in Title 40 of the Code of Federal Regulations (CFR), §124.8, the purpose of this fact sheet is to briefly describe the principal facts and the considerations that went into preparing the above referenced Draft Class V Experimental UIC Permit. To meet these objectives, this fact sheet contains background information on the permit process, a description of the facility, a brief discussion of the specific permit conditions, and the reasons for these permit conditions.

Injection wells are regulated by EPA under the authority of the UIC program, as provided for by the provisions in the Safe Drinking Water Act (SDWA). The UIC program regulates the subsurface injection of fluids below, into and above underground sources of drinking water (USDWs). A USDW is defined as any ground water containing 10,000 milligrams per liter or less of total dissolved solids, in a sufficient quantity to supply a public water system.

II. Permit Process

Application and Review Period

The U.S. Environmental Protection Agency, Region 9 (EPA) Water Division Director, as an authorized representative of the Administrator for Region 9, may issue permits for underground injection activities

under 40 CFR §144.31. Pacific Gas and Electric Company (PG&E) is applying for UIC permit number R9UIC-CA5-FY13-1 to construct and operate one Class V experimental compressed air energy storage (CAES) injection/withdrawal (I/W) test well, known as the PG&E CAES I/W Test Well. In addition, the project will involve conversion of two nearby wells into observation wells: Piacentine 1-27, an existing gas supply well, and Piacentine 2-27, an existing core well.

The proposed I/W well would be part of the PG&E CAES feasibility study project, as follows: because wind and solar resources are by nature variable (i.e., the sun does not always shine and wind does not always blow when power is actually needed), the addition of these methods of energy generation presents challenges to the operation of the power grid. Energy storage has been identified as an important component of a way to facilitate the use of wind and solar power for energy generation and distribution. CAES, i.e., storing energy in the subsurface in the form of compressed air, has been identified as a key enabling technology for expanding reliance on renewable resources for electricity production.

If authorized, the test injection/withdrawal well will be used to inject oxygen-depleted air into a depleted natural gas reservoir in the King Island Gas Field for the purpose of building an "air bubble" as part of a 90-day Compression Test. During and after the building of the "air bubble," a series of injection, shut in, and flow tests will be conducted to investigate the reservoir's performance for CAES application. Additional monitoring will follow the CAES test for a period of approximately six to nine months to evaluate reservoir pressure behavior in the post-test period.

PG&E originally submitted an application for a UIC Permit on May 3, 2013. The application was revised and resubmitted with supporting attachments between June 2013 and July 2014. After completing a thorough technical review of all submitted information, EPA has determined that the information provided by PG&E is sufficient to issue a draft permit. Accordingly, EPA is seeking public comments on a Draft Class V Experimental UIC Permit (draft permit) that would provide authorization to construct, test, and inject at the proposed PG&E CAES I/W Test Well. The total duration of this authorization would be five (5) years to allow sufficient time for well construction, testing, post-test monitoring, and well plugging and abandonment. The draft permit contains operation, maintenance, monitoring, reporting, and abandonment requirements.

Public Participation

The public has thirty (30) days to review and comment on the draft permit (40 CFR §124.10). The draft permit and this fact sheet are available at the following location:

Lodi Public Library
201 W. Locust Street
Lodi, CA 95240
Telephone: (209) 333-5566

The draft permit, this fact sheet, and the permit application are available at the following location:

U.S. Environmental Protection Agency Environmental Information Center/Library
75 Hawthorne Street
San Francisco, CA 94105
Telephone: (415) 947-4406
Email: library-reg9@epa.gov

The draft permit, this fact sheet, and the permit application are also available at the following EPA Region 9 webpage: http://www.epa.gov/region09/water/groundwater/uic-permits.html.

The public comment period begins on July 14, 2014 and ends on August 12, 2014. During this period, all written comments on the draft permit can be mailed, faxed, or emailed to Michele Dermer (see the contact information listed on the first page of this fact sheet), who is also available by phone for any questions regarding the draft permit.

All persons, including the applicant, who object to any condition of the draft permit or EPA's decision to prepare a draft permit must raise all reasonably ascertainable issues and submit all reasonable arguments supporting their position by the close of the comment period (40 CFR §124.13). A public hearing may be held only if there is a significant degree of public interest in the draft permit (40 CFR §§124.11 and 124.12).

Final Decision-Making Process

After the close of the public comment period, EPA will review and consider all comments submitted during the comment period that are relevant to the draft permit and application. EPA will send a response to comments to the applicant and each person who has submitted written comments or requested notice of the final permit decision. EPA will also post the response to comments document on its website. The response to comments will contain: a response to all significant comments on the draft permit, EPA's final permitting decision, any permit conditions that are changed and the reasons for the changes, and procedures for appealing the decision. The final decision shall be to either issue or deny the permit. The final decision shall become effective no sooner than thirty (30) days after the service of the notice of decision. Within thirty (30) days after the final permit decision has been issued, any person who filed comments on the draft permit, participated in any public hearing on this matter, or takes issue with any changes in the draft permit, may petition the Environmental Appeals Board to review any condition of the permit decision. Commenters are referred to 40 CFR §124.19 for procedural requirements of the appeal process. If no comments request a change in the draft permit, the permit shall become effective immediately upon issuance (40 CFR §124.15).

III. Description of the Project

The United States Department of Energy, the California Public Utilities Commission, and the California Energy Commission have funded PG&E to investigate the viability of using a depleted natural gas field to store energy by injecting compressed air into a subsurface reservoir during periods of excess generation when renewable energy is available, and recovering it by generating electricity using turbo-generation equipment during peak demand periods. The PG&E CAES feasibility study is an investigation into the design, performance, and reliability considerations associated with using a depleted natural gas reservoir for air storage in a CAES application. The results of the project will help to develop best practices and accelerate the market-readiness of the technology in the United States. The proposed project is a short-term, scaled test to assess the properties of a storage reservoir and evaluate the implications of the results in consideration of a potential full-scale, long-term CAES application.

After a review of depleted gas reservoirs throughout Northern California, PG&E selected the King Island Gas Field to perform reservoir pressure testing for the CAES feasibility study. The proposed Compression Test phase includes installation and use of the PG&E CAES I/W Test Well. The proposed PG&E CAES I/W Test Well will be located in Section 27, Township 3 North, Range 5 East, Northwest ¼ of the King Island Gas Field in rural San Joaquin County, approximately 2.5 miles west of the City of Lodi, CA.

Prior to any drilling, PG&E must submit specific proposed field coordinates for the surface and bottom hole locations of the I/W Test Well. The work will include expansion of an existing drilling pad and

improvement of access roads as needed, drilling of the injection/withdrawal well, converting two existing nearby wells into observation wells, installation of an electrical power supply and distribution system, and temporary mobilization of air compression equipment and other equipment needed to perform the test. The PG&E CAES I/W Test Well will be drilled directionally and deviated from vertical as described in the proposed drilling program included in Attachment L of the permit application and in Appendix B of the draft permit.

To conduct the compression test, compressed, oxygen-depleted air will be injected into the PG&E CAES I/W Test Well to create an "air bubble" within the boundaries of the original gas pool. During the approximately 90-day test, the PG&E CAES I/W Test Well will be used to perform a series of injection, withdrawal, pressure fall-off, and build-up tests while monitoring the PG&E CAES I/W Test Well and the observation wells. After completion of the test, a monitoring period will follow for a period of approximately six to nine months to evaluate post-test pressure declines. After the monitoring period, a decision will be made to either shut the well in and place it in inactive status, or plug and abandon the well.

The data collected during the compression test will aid in the assessment of reservoir performance on a pilot scale. The data from the test will be used to refine the computer model of the reservoir and to develop a conceptual design for full-scale reservoir development to support a CAES plant. Test data will also support subsequent engineering, economic, and environmental evaluations, and be used to finalize the project feasibility analysis.

The maximum permitted injection pressure measured at the wellhead will be based upon the results of step-rate tests (SRTs) run during well construction. The injection rate will not exceed 14 million standard cubic feet per day (MMscfd) at any time and the actual injection volume will not exceed 560 million standard cubic feet (MMscf) cumulatively.

The primary injection interval has been identified as the Mokelumne River Formation (MRF) gas reservoir sand, and is expected to consist of at least 40 feet of net sand thickness at the PG&E CAES I/W Test Well site at depths of approximately 4,681 to 4,721 feet true vertical depth. The overlying confining layers at the PG&E CAES I/W Test Well site are the 35- to 110-foot thick Capay Shale immediately above the proposed injection target interval, and shale layers in the upper section of the Meganos Channel Fill Formation that truncates the MRF reservoir sand unit at the periphery of the reservoir.

IV. Brief Summary of Specific Permit Conditions

In order to protect public health and the environment, EPA is proposing the following permit conditions for pre-drilling requirements, construction, corrective action, operation, monitoring and reporting, plugging and abandonment, financial responsibility, and duration of the permit:

Requirements Prior to Drilling, Testing, Constructing, or Operating (Part II, Section A of the draft permit)

The permit requires PG&E to provide evidence of financial assurance prior to starting injection well drilling and construction. In addition, the permit calls for adequate notification of activities to construct, test, and operate the proposed facility and timely reporting of those activities.

Well Construction (Part II, Section B of the draft permit)

The permit requires notification of the precise location of the PG&E CAES I/W Test Well, as well as its distance to the two observation wells.

Logs and other tests to be performed during drilling and installation must include deviation checks, directional surveys, casing logs, and injection formation tests. Open-hole logs must be conducted over the entire open-hole sequence below the conductor casing. The Permittee is required to conduct formation evaluation wireline logging and testing operations, and to provide and use those results to estimate and report values for hydrocarbon saturation, porosity, permeability, lithology, formation water resistivity, total dissolved solids (TDS) concentrations, and rock mechanical properties for both the injection and confining zones identified within the permitted geological sequence, and for selected intervals for identification of any USDWs above the injection zone. In addition, sidewall core samples for the injection and confining zones must be collected and analyses must be reported to EPA.

The draft permit requires injection formation testing to include: groundwater testing to demonstrate the presence or absence of any USDW and the characteristics of the formation; step-rate tests to establish maximum allowable injection pressure; and fall off pressure testing (FOT) to determine and monitor formation characteristics.

Drilling, work-over, and plugging procedures must comply with the applicable California Division of Oil, Gas, and Geothermal Resources regulations. The Permittee is required to case and cement the wells to prevent the movement of fluids into or between USDWs. The injection interval within the MRF will be from about 4,730 to 4,772 feet measured depth and 4,681 to 4,721 feet true vertical depth. The overlying confining layers at the PG&E CAES I/W Test Well site are the 35- to 110-foot thick Capay Shale immediately above the proposed injection target interval, and shale layers in the upper section of the Meganos Channel Fill formation that truncates the MRF reservoir sand unit at the periphery of the reservoir.

The draft permit also requires installation and maintenance of monitoring devices necessary to obtain samples of the injection gases, and to continuously measure and record injection pressure, annulus pressure, flow rate, and injection volumes. Hydrocarbon, flame, and redundant oxygen sensors are required and must be hard wired to a central data acquisition and control module, which must be equipped with an uninterruptable power supply. The PG&E CAES I/W Test Well must have downhole and wellhead pressure-temperature (PT) sensors to monitor reservoir pressure and prevent exceedence of the maximum allowable injection pressure, as well as an annular PT sensor to monitor mechanical integrity. The observation well at Piacentine 1-27 must also have wellhead and annular PT sensors to monitor reservoir pressure and mechanical integrity.

A Final Well Construction Report and a Notice of Completion of Construction must be submitted to EPA. The Permittee must give advance notice to EPA of any planned physical alterations or additions to the permitted injection well or the observation wells.

Corrective Action (Part II, Section C of draft permit)

Corrective action is not required for existing wells within the Area of Review for the PG&E CAES I/W Test Well, subject to a review of additional data collected before EPA authorizes injection. The Zone of Endangering Influence (ZEI) will be re-evaluated after the Permittee collects logging and formation test data from the proposed well. The data will be used by the Permittee to confirm or modify assumptions used to calculate the original ZEI. In addition, the ZEI will be reviewed based on any new well testing data; if any wells requiring corrective action are found within the modified ZEI, EPA must be notified and proper plugging and abandonment must occur.

Well Operation (Part II, Section D of the draft permit)

Prior to injection, the Permittee must demonstrate that the PG&E CAES I/W Test Well and the observation well Piacentine 1-27 maintain proper mechanical integrity. Observation well Piacentine 2-27, which is not perforated, may require temperature logging to assess fluid movement in the cemented annulus if reservoir pressure remains above hydrostatic pressure in the post-test monitoring period. The Permittee must also demonstrate that hazardous waste is not going to be injected into the subsurface. The draft permit requires regular mechanical integrity tests (MITs) via casing/tubing annular pressure, continuous pressure monitoring, injection profile survey, and cement evaluation analysis to ensure protection of USDWs. Loss of mechanical integrity requires notification of EPA and action to restore mechanical integrity or plug and abandon the well.

Injection pressure limitations will be based upon the results of a SRT performed during well completion. The permit also requires that PG&E operate their injection well in such a manner as to not initiate or propagate fractures in the injection formation or the confining zone, nor to cause migration of fluids into or between USDWs. The injection rate for the PG&E CAES I/W Test Well cannot exceed 14 MMscfd at any time and the actual injection volume cannot exceed 560 MMscf cumulatively. Injection fluids will consist of oxygen-depleted air (<5% oxygen), and possibly ambient air.

Monitoring, Record Keeping, and Reporting of Results (Part II, Section E of draft permit)

The draft permit requires continuous monitoring of injection rate, total cumulative volume, wellhead injection pressure, annular pressure, oxygen content, and injection fluid temperature, as well as daily monitoring of injection volume. The injectate fluid (gas) will be sampled at or before the wellhead at startup and end of the initial oxygen-depleted air injection and at startup and end of ambient air injection, if conducted, and the resulting samples will be analyzed for oxygen content. The Permittee is required to maintain all operational and monitoring records, and to submit monthly summary reports to EPA during the 90-day Compression Test and quarterly summary reports during the post-test monitoring period.

Plugging and Abandonment (Part II, Section F of the draft permit)

After cessation of injection operations for two (2) years, the Permittee must plug and abandon the inactive well(s) regulated by this draft permit in accordance with the Plugging and Abandonment Plans in Appendix G unless the Permittee: provides notice to EPA, has demonstrated that the well(s) will be used in the future, and describes actions or procedures to ensure that the well(s) will not endanger USDWs during the period of temporary abandonment. The inactive I/W Test Well and the Piacentine 1-27 well must pass an internal MIT before EPA authorizes temporary abandonment status, and an internal MIT is required every two (2) years while in temporary abandonment status. EPA reserves the right to change the manner in which a well will be plugged if the well is modified during its permitted life or if the well is not consistent with EPA requirements for construction or mechanical integrity.

Financial Responsibility (Part II, Section G of the draft permit)

The Permittee must post an approved financial instrument to demonstrate adequate financial responsibility in the amount of $1,269,000. Continued authorization to inject and operate the well under the authority of this permit will be granted only after the financial instrument has been reviewed and approved by EPA. The financial responsibility mechanism and amount will be reviewed and updated periodically, upon EPA request.

Duration of Permit (Part II, Section H of the draft permit)

EPA proposes to issue the permit and the authorization to inject for a period of up to five (5) years unless terminated under the conditions set forth in Part III, Section B.1 of the draft permit.