

APPENDIX G

GAS MONITORING PLAN

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Background

The Gill Ranch Gas Storage Field is located in an area that has been historically used for gas exploration and production. This history dates back over 60 years and involves more than 40 exploratory and production wells and billions of cubic feet of gas produced through wells and a steel pipeline gathering network. Information regarding the current natural gas background at the surface will be developed before the Gill Ranch Gas Storage Project (Project) operations commence, so that there is a solid baseline against which to compare future Project-related gas monitoring results.

Objective

Natural gas migrating to the surface from an underground gas storage operation such as the Project is expected to be a rare and unusual event. It is possible that natural gas from a variety of sources other than underground gas storage will be detectable within the Project Area boundaries. These sources could include:

- Naturally occurring biogenesis of organic matter at various depths
- Remnants of gas from the production well operations
- Leakage from production pipelines or wells in the Project Area

The overarching objective of this Gas Monitoring Plan is to protect health and safety and the environment and to facilitate the determination of the source of any detectable natural gas at or near the ground surface in the future, whether from the storage operation or some other source(s), so that appropriate corrective measures can be taken.

Gas Monitoring Program

INTRODUCTION

The four primary elements of the Gas Monitoring Plan are:

- 1) **Establish a baseline** (background) level for natural gas at the ground surface, if any, prior to beginning storage operations. This will allow comparison and sound evaluation of future Project-related gas monitoring results.
- 2) **Periodically measure** for levels of detectable gas at pre-determined surface locations. This will allow the storage operator to ascertain whether the levels of gas detected at the surface, if any, have increased noticeably above the previously established background levels. It is expected that small variations may occur that may not individually rise to any significant level; however, trends over several sample periods could provide an indication of a change that will require further investigation.
- 3) **Quantify** and, if necessary, qualify any changes in an attempt to identify the source. First, based on sampling and testing of gas samples, it should be determined whether the gas quality signature is similar to the baseline survey results or to pipeline gas. Gas in the storage reservoirs will be almost exclusively pipeline gas with components that should be identifiable compared to native thermogenic gas or biogenic gas.
- 4) **Respond** to the data and corresponding analysis with additional testing, surveillance, or mitigation, as appropriate, based on any specific changes observed. All monitoring data shall be reported to the California Department of Oil, Gas, and Geothermal Resources (DOGGR) and copied to California Public Utilities Commission (CPUC) on a quarterly basis (four times per year). Any condition that require Immediate Action (as defined in Table G-1 in this Gas Monitoring Plan shall be reported to the DOGGR and CPUC as soon as possible, and measures shall be taken that are in accordance with the site Health and Safety Plan and the site Emergency Response Plan required by the Initial Study/Mitigated Negative Declaration. In any such case, a plan shall be developed to identify the

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leaking pipeline, well, or reservoir, including procedures to further test and correct the situation if data indicate that any detected surface gas is from the storage operation. If it appears that the source of any gas is related to a non-storage facility, the operator shall notify DOGGR and CPUC and diligently attempt to identify the owner or operator of that facility and inform them of the monitoring results.

- 5) The overall gas monitoring program will be evaluated after 1 year, and annually thereafter, in order to evaluate whether changes in the monitoring frequency are justified, based on the monitoring data obtained to date. If at the end of any monitoring period, monitoring data shows no or *de minimus* changes in natural gas at the surface compared to the baseline or the prior year's monitoring data, then the Project operator may (1) provide Energy Division with information demonstrating no or *de minimus* changes have occurred during the relevant monitoring period, and (2) request Energy Division approval to change the monitoring frequency to 1 year or another appropriate frequency.

The monitoring program consists of the following features:

- Permanent monitoring/testing sites at the Project well sites
- Leakage survey along existing County and private farm roads on a regular basis
- Utilize standard, industry approved gas measurement equipment
- Field personnel trained on gas sampling methods and instrumentation, identifying stressed vegetation and other indicators of potential leakage

GAS MONITORING LOCATIONS

Two permanent test stations will be located at each of the Project injection/withdrawal well sites. Two additional test stations will be installed at the compressor station site. One will be near the salt water disposal well within the 10-acre compressor station area, and the other will be near the foundation of the compressor station building. Each test station will consist of a shallow gas monitoring probe constructed in accordance with specifications cited in California's Advisory for Active Soil Gas Investigations (California EPA 2003), Section 2.2.

A permanent or a temporary gas monitoring probe shall be used to monitor each of the 17 existing wells in the gas field that have been identified by the Applicants that penetrate the Starkey Formation above the original gas/water interface (Entrix 2008). Any residence or other building located within the boundaries of the Gill Ranch Storage Field that is occupied at some point during the period of measurement (quarterly, or as modified) shall be included as a monitoring point. Permanent or temporary gas monitoring probes shall be constructed in accordance with specifications cited in California's Advisory for Active Soil Gas Investigations (California EPA 2003), Section 2.2.

GAS SAMPLING

When required by this plan, gas samples shall be collected in accordance with methods specified in Sections 2.5 and 2.6 of California's Advisory for Active Soil Gas Investigations (California EPA 2003), noting the special procedures for methane in Section 2.7.9. Purging of each gas probe shall be conducted prior to its sampling. Baseline measurements for the permanent gas monitoring probes, using portable analytical gas instruments, will be made no sooner than 48 hours after the installation of the test station, whereas baseline measurements for the temporary gas probe locations can be taken within the same hour of installation of the probe.

BASELINE MEASUREMENT

Prior to commencing Project injection operations, a baseline survey shall be conducted at each of the established permanent and temporary test probe sites utilizing a portable gas detection instrument. At any site where the baseline level reading exceeds 100 ppm of combustible gas, a

gas sample shall be taken for laboratory analysis of hydrocarbons (including methane), hydrogen sulfide, and other constituents suitable for distinguishing between pipeline gas, reservoir gas, and biogenic gas. Samples for laboratory analysis shall be taken at the applicable permanent and temporary gas probe location(s), at the same time as the field analysis measurements are taken using portable gas detection instruments. Additional samples for laboratory analysis shall be taken at other times, as appropriate to identify the source of any elevated concentrations of methane, including times when there is methane detected at concentrations that exceed 10 times background, or 1%, whichever is lower.

GAS TESTING

All test sites shall be identified and surveyed for location, and all test data shall be gathered and recorded. The testing program shall be conducted at least once prior to initiation of injection (for baseline conditions), and at quarterly intervals after injection commences. Gas testing and sampling shall be conducted during periods of relatively higher gas pressures within the sampling quarter, whenever possible. Any measurement (field or laboratory) data that exceed the Immediate Action or Timed Action criteria set forth in Table G-1 must be reported to the CPUC and DOGGR on a quarterly basis at a minimum, or as directed in Table G-1.

Laboratory analyses shall be conducted using methods specified in Section 2.7 of California's Advisory for Active Soil Gas Investigations (California EPA 2003), noting the special procedures for methane in Section 2.7.9.

Portable combustible gas detection instruments will consist of infrared gas analyzers or other suitable combustible gas analyzers such as a Landtech Gem 500 or Gem 2000 landfill gas monitors. All portable analytical gas equipment will be calibrated according to the manufacturer's procedures daily when in use unless manufacturer's procedures indicate a different schedule of calibration is appropriate, using a laboratory-certified methane calibration gas. The methane detection limit for portable analytical equipment shall not be above 1000 parts per million by volume (ppmv).

Gill Ranch Storage, LLC (GRS) shall locate each of the abandoned wells that have penetrated the potential Starkey storage reservoirs to depths above or near the original gas/water contact, and will conduct a conventional location survey or a Global Positioning Satellite (GPS) survey to obtain GPS coordinates for each well, using a licensed surveyor. GRS will submit all location survey information to DOGGR. Leakage surveys will be conducted at each of these abandoned wells sites, and at any residences or other buildings on the Gill Ranch Storage Field that are occupied on a regular basis under the same conditions and at the same frequency as the permanent test stations described above.

Leakage surveys shall be conducted along existing County and private farm roads in the Project Area. The leakage surveys will be conducted annually in conjunction with the transmission pipeline leakage surveys. The surveys will utilize industry standard and accepted equipment, which will be calibrated as required by the manufacturer. Once the baseline level is determined, the sampling and measurement program will be focused on evaluating incremental changes to the background levels.

RESPONSE PROTOCOL

The following guidelines will be used to aid in the development of a response plan. Methane gas concentrations will be categorized by location, proximity to an occupied building, concentration, and historical changes in the measurements. In making the determination as to what level of methane gas concentration represents a hazard, the location of the detectable gas is a critical factor and the specific remediation requirements will differ from situation to situation. Table G-1 lists action criteria for various potential leakage conditions.

Table G-1: Leakage Conditions Action Criteria		
Leakage Condition	Immediate Action	Timed Action
	A leak of storage gas that represents a probable hazard to persons or property and requires prompt action, immediate repair, or continuous action until conditions are no longer hazardous	A leak of storage gas that does not require Immediate Action and can either be remedied during a scheduled repair or can reasonably be expected to remain in a condition that does not require Immediate Action
Action Criteria	<i>Requires prompt action to protect life and property and continuous action until the conditions are no longer hazardous. Any such leaks of storage gas must be repaired as soon as possible, without endangering health and safety.</i>	<i>A leak of storage gas that needs remedy must be repaired within 6 months from the date the leak was discovered. Must be reevaluated at least once every 30 days after the repair has been completed until there are at least two consecutive measurements separated by at least 1 week that indicate concentrations are below levels that require Timed Action or Immediate Action</i>
Storage gas in the vicinity of outside wall of building	A methane concentration greater than 0.1% absolute (1000 ppmv) measured within 5 feet of the outside wall of a building or where storage gas could potentially migrate to an outside wall of a building	A methane concentration of 0.1% absolute (2% Lower Explosive Limit [LEL]) or more within 10 feet of an outside wall of a building, or under a sidewalk, under a clay or caliche soil, or under a paved area, where storage gas could potentially migrate to within 10 feet of, the outside wall of a building
Storage gas at permanent monitoring station (shallow soil or open air)	A leak of storage gas that can be seen, heard, or felt or any methane concentration measurement of 1% absolute (20% LEL) or greater	A leak of storage gas that has occasional to moderate odor or has a methane concentration equal to or greater than 0.1% absolute but less than 1% absolute, and can reasonably be expected to remain in a condition requiring Timed Action but not Immediate Action
Incremental substantial increase in background storage gas concentration	Background levels of methane increased by tenfold at either a permanent monitoring station or from data recorded from the annual pipeline and road leakage survey	Background levels of methane increased at least twofold but less than tenfold, and not to a level to create a condition requiring Immediate Action.
Detectable storage gas along roadway or gathering pipeline route	Any methane concentration measurement that equals or exceeds 1% absolute (20% LEL)	Any methane concentration measurement that is equal to or above 0.1% absolute but less than 1% absolute (20% LEL)

References

- California EPA (California Environmental Protection Agency). 2003. Advisory – Active Soil Gas Investigations. Department of Toxic Substances Control, and Los Angeles Regional Water Quality Control Board. January 28, 2003. 24 pp.
- Entrix. 2008. Proponent's Environmental Assessment and Supplemental Materials for the Gill Ranch Gas Storage Project prepared for Gill Ranch Storage, LLC and Pacific Gas and Electric Company. July 2008.

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