Title: Removal and Control of Liquids from Pipelines and Maintenance and Operation of Associated Gas Conditioning Equipment

Overview

This document describes requirements for controlling and removing liquids from Pacific Gas and Electric Company's (the Company's) gas pipelines and procedures for inspecting and maintaining natural gas conditioning equipment.

Governing Document

Utility Standard S4330, "Natural Gas Quality"

Safety

Perform all gas maintenance and operations and associated work safely and in accordance with all applicable safety rules, the *Code of Safe Practices*, and Utility Standard Practice (USP) 22, "Safety and Health Program."

Liquid Control and Removal Requirements and Responsibilities

All gases entering the Company's gas gathering or transmission and distribution systems must contain no free liquids. Immediately control a source that delivers free liquids with the gas stream. Formally notify the responsible producer to eliminate the cause of liquid production, and/or shut off the source after obtaining clearance from Gas Systems Operations (GSO) in accordance with notification procedures.

1. Requirements

A. Drips and Gas Liquid Separators

1. When free liquids are known or suspected to have condensed in the transmission and distribution system, districts install liquid removal facilities such as drips and gas–liquid separators at effective locations. The decision to install liquid removal facilities is based on customer and/or operational impact, internal corrosion mitigation, and cost. Pursue a pigging program when liquids are known to accumulate in pipeline segments.
2. Monitor gas–liquid separators at least monthly to ensure proper operation.
3. Perform maintenance of gas–liquid separators in accordance with the equipment manufacturer's recommendations.

[redacted] [redacted]

4. Periodically drain offset and drop leg drips, bottom-tapped drains, and siphon drips equipped with manually controlled liquid dump valves to prevent excessive accumulation of liquids in the pipeline. Determine the draining frequency from historical liquid volume noted at each location and the liquid's corrosivity. Refer to the *Corrosion Manual* for testing and determining corrosivity of liquids. Request a copy of the manual from the local environmental consultant.
5. Periodically inspect offset and drop leg drips equipped with automatic liquid dump valves and liquid storage tanks for proper operation, according to inspection requirements in the facility's environmental and safety plan.
6. Refer to the *Environmental Compliance Guidance Manual* for procedures to handle, transport, and dispose of liquids removed by drips and gas–liquid separators. Request a copy of the manual from the local environmental consultant.

B. Internal Corrosion Control

1. Corrosive gas is not transported by pipeline unless the corrosive effect on the pipeline has been investigated and steps have been taken to minimize internal corrosion. Steps can include removing and controlling liquids in the pipeline and using appropriate corrosion inhibitors to treat any residual liquids in the pipeline section.
2. Inspect the internal surface of any section of a removed pipeline for evidence of corrosion, no matter why the section was removed. If internal corrosion is found, investigate the adjacent section of pipe to determine the extent of internal corrosion. If additional corrosion is found in the adjacent pipe, the damage must be evaluated and repaired or replaced, if necessary.
3. Use the industry standard software, Remaining Strength of Corroded Pipe (RSTRENG), furnished by the American Gas Association (AGA) to evaluate the corrosion data. Alternatively, the American Society of Mechanical Engineers (ASME) B31G may be used in lieu of RSTRENG. Document each inspection on Form 62-4060a, "Leak Survey, Repair, Inspection, and Gas Quarterly Incident Report."
4. If pipeline liquid analysis or other evidence indicates internal pipeline corrosion, take steps to minimize and monitor the corrosion, regardless of whether any section of pipeline has been removed for inspection. Refer to the guidelines in the *Corrosion Manual*.

C. Instrument Gas Supply Dehydration

Equip instrument gas supply racks at all locations in the gas gathering, transmission, and distribution systems with suitable dehydration equipment and filters to protect the instruments from freezing and/or being clogged with any solids or deposits. Refer to Numbered Document G-40, "3/4" Dehydrator for Instrument Lines 1,200 PSIG Design Pressure," for detailed design, installation, and maintenance of instrument gas dehydrators.

[redacted] [redacted]

D. Gas Dehydration Facilities

Natural gas entering the Company's transmission and distribution system must be dehydrated to 7 pounds of water vapor/million standard cubic feet (MMscf) or less. Exceptions require approval of the Gas Transmission and Distribution (GT&D) district superintendent, Gas Systems Operations (GSO), and the affected service areas. Exceptions may be allowed depending on the following factors:

- Gas delivery location.
- Pressure.
- Gas flows.
- Thorough evaluation by GT&D, GSO, and the affected service areas.

E. Water Content or Water Dew Point Tests

1. Take water content measurements at the points of entry of out-of-state gas into the gas system and at any point along pipelines where additional undehydrated gases enter a pipeline transporting dehydrated gas.
2. Record the measurements in the station log at least monthly. Refer to Numbered Document N-93, "Equilibrium Moisture Content of Natural Gas," to estimate the amount of water vapor that can be in saturation with the gas at various temperatures and pressures. This nomograph can also be used to convert water dew point temperatures to units such as pounds of water/MMscf of gas at a given pressure.

F. Reporting and Recordkeeping

1. Record liquid removal from pipeline drips on the station logs and Form 62-4648, "Pipeline Patrol and Work Report."
2. Record liquid removal from bottom-tapped drains on the same form and clearly note as "Bottom-Tapped Drain."
3. Distribute reports within the district and the affected service areas as required for proper attention and follow up. The records will be retained at the local district office for the life of the pipeline.
4. Records indicating the results of each internal corrosion inspection are recorded on Form 62-4060a, "Leak Survey, Repair, Inspection, and Gas Quarterly Incident Report (Form A)." The records will be retained at the local district office for the life of the pipeline.
5. Use Form 62-3085a, "Dehydrator Station Inspection Form Glycol Dehydrator" or Form 62-3085b, "Dehydrator Station Inspection Form Dry Desiccant Dehydrator" to record monthly dehydration facility inspections. The records will be retained for a minimum of 6 years by the district that operates the facilities.

[redacted] [redacted]

2. Responsibilities

A. Gas Engineering system standards management section is responsible for defining the acceptable levels of free liquids and water vapor in the gas stream by soliciting input from various GT&D departments and the service areas.

B. GT&D district foremen or gas operating supervisors have the following responsibilities:

- Surveying the system and determining sources of liquids.
- Monitoring suspected sources of liquids.
- Scheduling periodic extraction of liquids from drips and separators.
- Operating and maintaining gas dehydration facilities.
- Taking periodic dew point measurements.
- Operating and maintaining inhibitor injection facilities in the gas gathering systems.
- Operating and maintaining the internal corrosion monitoring devices.
- Establishing and maintaining reports and records of all of the above.
- Managing any liquids removed and collected from liquid removal and gas conditioning equipment in their respective facilities in accordance with all applicable safety and environmental regulations. See the local environmental consultant for specific liquids management procedures.

C. Each district superintendent is responsible for initiating action and overseeing corrective measures, such as shutting off gas supplies that produce excessive liquids, to resolve abnormal operating conditions. The district superintendent communicates and coordinates the actions with GSO and the affected areas.

D. The area gas operating supervisor, or employee equivalent, reports to the appropriate GT&D district superintendent and GSO on any abnormal conditions involving liquids collected in the gas distribution system. The organizations conduct a joint investigation to resolve the issue.

E. The GT&D facility and pipeline engineer(s) and internal corrosion engineer are available to the GT&D district superintendent for engineering and auditing services for proper maintenance and operation of facilities that remove and control liquids and the associated gas conditioning equipment. The GT&D facility and pipeline engineer(s) and internal corrosion engineer must review the monthly reports generated by the districts and initiate any necessary corrective measures that result from the review.

3. Training

A. Arrange training of district gas personnel for maintenance and operation of facilities that remove and control liquids and the associated gas conditioning equipment such as gas–liquid separation, dehydration, and dew point analyzers, through the GT&D facilities engineer.

[redacted]

B. Arrange training of district gas personnel for maintenance and operation of corrosion inhibitor injection facilities and monitoring instruments through the GT&D internal corrosion engineer.

Dehydration Equipment Maintenance Procedure

1. Gas Dehydration Facilities Monthly Maintenance

A. Include water vapor dew point measurement on both inlet and outlet gas from the dehydrator in monthly maintenance and operation procedures for glycol dehydration facilities. Check each of the following items:

- Condition of the glycol.
- Pump operations.
- Flange fittings, connections, etc., for leaks.
- Instrumentation for proper operation.

B. Inspect dry desiccant-type dehydration facilities at least once a month. Maintain the facilities in accordance with the manufacturer's recommendations.

C. Maintain monthly records of the following information for each district:

- Dew point readings at gas dehydration locations.
- Location and quantities of free liquids removed each month from pipeline gathering, transmission, and distribution systems.
- Action taken by the responsible supervisor to correct any abnormal operating conditions of gas conditioning facilities.

Record the information on the appropriate dehydrator station inspection report, Form 62-3085a or 62-3085b. Distribute the report within the district and the affected service areas as required for proper attention and follow-up. Forward a copy of the report with the GT&D district superintendent's or gas operating supervisor's review and approval to the Gas Engineering mapping & records section.

Note: Use forms and procedures described above until the appropriate modules in GT&D maintenance management system are in place. When GT&D's maintenance management system is operational, dehydration facility inspections must be recorded in that program.

D. Perform water vapor dew point tests at least monthly with dew point analyzers approved by GT&D. Only trained personnel perform these tests. For a list of approved dew point analyzers and details of appropriate type(s) of analyzer(s) for a given application, refer to UO Guideline G14362, "Maintenance and Operation of Water Dew-Point Test Instruments for Natural Gas Pipeline Applications."

[redacted] [redacted]

2. Maintenance of the Triethylene Glycol Solution

A. Monthly Inspection

The GT&D district superintendent coordinates any laboratory analysis of the TEG solution with Technical and Ecological Services (TES)/chemical analysis section or an outside laboratory. Evaluate the condition of the triethylene glycol solution used in gas dehydration as follows:

1. Measure the potenz Hydrogen (pH) of the triethylene glycol (TEG) every month using a properly calibrated pH meter and a 50:50 mixture of the glycol with distilled water. The pH of the glycol is an indicator of its corrosivity. The desired pH range for the TEG is 7.0 to 8.0. Specific guidelines for measurement and adjustment methods of glycol pH are below in Section 4.
2. Analyze field samples of the representative "wet" and "dry" TEG solution at least annually to monitor the quality of the glycol. The TEG solution is used in the dehydrator for a long period of time. It can become contaminated with hydrocarbons and other wellhead chemicals. TEG can also break down after long-term use and elevated temperatures. Typical laboratory analysis checks for chromatographic analysis as to percentage (%) of water,
% hydrocarbon, % ethylene glycol, % diethylene glycol, % triethylene glycol, pH, chlorides, iron, and foaming tendency.

B. 3-Year Inspection

Based on the district's experience, but at least every 3 years, drain the glycol reboiler and remove and inspect the fire tube for deposit buildup and cracks. When necessary, the GT&D district superintendent coordinates any purchase of fresh triethylene glycol with the materials and fleet department.

1. Inspect the contactor tower and reboiler internal parts, bubble caps, valves, pumps, instrumentation, and controls for wear. Replace items with higher than normal failure rates (such as ultraviolet [UV] detectors, flame rods, dump valve trim, filter elements, etc.).
2. Drain all TEG solution from the reboiler and recycle, whenever practical, or replace. Consult the GT&D facilities engineer or the manufacturer for cleaning and flushing procedures for the various dehydration equipment. For specific information on glycol recycling and approved glycol recycling companies, refer to the *Environmental Compliance Guidance Manual*. Contact the local environmental consultant to arrange for recycling or disposal of spent TEG.
3. The GT&D district superintendent records inspection and maintenance jobs frequency, job completion dates, and any historical details associated with maintenance of the dehydration equipment. The superintendent uses the appropriate preventive maintenance modules in the GT&D maintenance management system when it is available.

[redacted] [redacted]

3. Maintenance of the Dry Desiccant

A. Evaluate the condition of the dry desiccant in accordance with the manufacturer's recommendations.

B. The GT&D district superintendent coordinates any laboratory analysis of the solid desiccant with TES/chemical analysis section.

C. The GT&D district superintendent records job frequency, job completion dates, and any historical details associated with the maintenance of the dehydration equipment, in the preventive maintenance modules of the Maintenance Management System.

4. Measurement and Adjustment of Glycol pH in Gas Dehydration Facilities

A. Introduction

- By definition, pH is a measure of the acidity of an aqueous solution. A pH of 7.0 is neutral. A pH greater than 7.0 is alkaline (or basic) A pH less than 7 is acidic. Distilled water generally has a pH of 7.0.
- The pH is a good indication of the condition of the glycol and the chemical degradation that the solution may have undergone resulting from the thermal decomposition, oxidation, and contamination of the glycol solution. The desired pH range for glycols utilized in dehydration equipment is 7.0 to 8.0. A pH of 7.3 to 7.5 is ideal.
- The pH of the glycol solution in typical dehydration equipment will decrease (i.e., become more acidic) over a period of time as the unit operates, if corrective measures are not taken. Corrosion rates of the equipment exposed to the glycol solution will then increase rapidly with the decrease in glycol pH.

B. pH Measurement of Glycols

1. Check the pH of the glycol solution periodically. Use Dehydrator Station Inspection Form 62-3085a.
2. Measure the pH of glycols using a properly calibrated (potentiometric type) pH meter. Contact the GT&D facilities engineer for a list of approved suppliers.
3. Calibrate the pH meter with fresh buffer solutions of pH 4.0, 7.0, and 10.0 before making any measurements. The buffer solutions are available from most chemical suppliers or from the Company's TES/chemical analysis section. Contact TES's 24-hour service line at 1-8-251-3197 or (925) 866-3197.
4. Follow the operating instructions provided by the pH instrument manufacturer. Request any further assistance to service the pH meters by requesting a gas system maintenance facilities engineer or Technical and Ecological Services/chemical analysis section.
5. Use the pH paper only for checking the operation of the pH meter.
6. Take glycol samples from the glycol surge tank portion of the dehydration equipment.

[redacted] [redacted]

7. Allow the sample to cool down to ambient temperature or to at least 150° F because pH readings change with sample temperature.
8. Dilute the glycol sample 50:50 with distilled water to get accurate measurements.
9. Gently swirling or stirring the sample is often necessary to stabilize the pH readings.

C. Adjustment of the pH of Glycols

1. The pH of the glycol solution requires raising periodically as the glycol degrades with age (see Section 4-A, "Introduction," on page 7). This pH adjustment can be accomplished by adding a glycol pH increaser to the glycol. If necessary, any of the two glycol pH decreasers can be used to adjust the glycol pH if the glycol solution has become too basic. The frequency and quantity of the addition of any of the chemicals listed below is determined by pH measurements of the glycol solution:
   - Glycol pH increaser (and corrosion inhibitor) Code M490070
   - Glycol pH decreaser and buffer Code M490069
   - White vinegar (glycol pH decreaser only) available at local grocery stores
2. Add the chemical to the glycol surge tank of the reboiler premixed in a proportion of 1 quart of chemical to 5 gallons of dry glycol.
3. Allow the chemical to disperse into the solution and for the whole glycol solution to circulate at least once through the dehydration equipment.
4. Measure the resulting pH of the glycol solution to evaluate the effect of the chemical.
5. Repeat steps 2 through 4 until the desired pH range of 7.0 to 8.0 is achieved.

Definition of Terms

Acceptable Water Vapor Content of Gas: No more than 7 pounds of water vapor per million standard cubic feet of gas. By referring to the Numbered Document N-93, "Equilibrium Moisture Content of Natural Gas," this level is equivalent to a gas water vapor dew point of 32° Fahrenheit (F) for gas at 1,000 pound-force per square inch (psig) pressure.

GT&D Gas Quality On-Call Group: A technical resource that is available to GSO when corrective measures to gas quality system emergencies are needed. This group is composed of GT&D, GSO, and Gas Engineering members who understand the Company's gas quality and odorization programs and have received training covering the gas quality incident reporting process, emergency notification, and contingency procedures.

Corrosive Gas: Natural gas that contains levels of carbon dioxide or hydrogen sulfide that exceed acceptable limits. These carbon dioxide and hydrogen sulfide gases are also sometimes called acid gases because in the presence of water, they form acids or acidic solutions that are corrosive.

Free Liquid: Any measurable quantity of liquid, including water, hydrocarbon

[redacted] [redacted]

condensate, compressor oil, glycol, or other liquid contaminants condensed or produced into the pipeline and carried along with the gas stream.

Gas Conditioning Equipment: Equipment that is used to make the gas marketable and flow safely and reliably from the wellhead to the transmission and distribution systems. Examples of gas conditioning equipment are gas-liquid separators, dehydrators, and corrosion inhibitor injection units.

Gas Dehydration: Removing water vapor from the gas stream usually by contacting the gas with triethylene glycol or other hydroscopic (water-absorbing) desiccants.

Hydrocarbon Dew Point: The temperature at which hydrocarbons start to condense from the gas stream at a given pressure.

Liquid Removal Facilities: Equipment such as standard offset and drop leg drips, siphon drips, gas conditioning equipment such as gas-liquid separators, and scrubbers with or without liquid storage tanks and automatic liquid dumping features.

Water Dew Point: The temperature at which water vapor starts to condense from the gas stream at a given pressure.

Recision

This work procedure cancels and supersedes CGT Recommended Practice RP 4332, "Removal and Control of Liquids from Gas Pipelines Maintenance and Operation of Associated Gas Conditioning Equipment," issued May 1998, and Form 62-3085a, "Dehydrator Station Inspection Form," dated September 2004.

Reference Documents

California Public Utilities Commission (CPUC) General Order (G.O.) 112-E, "Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems"

Corrosion Manual

CPUC G.O. 58-A, "Standards for Gas Service in the State of California"

Environmental Compliance Guidance Manual

Numbered Document G-40, "3/4" Dehydrator for Instrument Lines 1,200 psig Design Pressure"

Numbered Document N-93, "Equilibrium Moisture Content of Natural Gas"

Numbered Document O-16, "Corrosion Control of Gas Facilities"

UO Guideline G14362, "Maintenance and Operation of Water Dew-Point Test Instruments for Natural Gas Pipeline Applications"

[redacted] [redacted]

Attachments

Attachment 1, Form 62-4648, "Pipeline Patrol and Work Report"

Attachment 2, Form 62-3085a, "Dehydrator Station Inspection Form *Glycol Dehydrator*"

Attachment 3, Form 62-3085b, "Dehydrator Station Inspection Form *Dry Desiccant Dehydrator*"

Contact for More Information [redacted]

Date Issued March 2008

Approved by [redacted]

Chg No.	Date	Description	By (LAN ID)
01	August 2007	Initial work procedure version	[redacted]

[redacted]

[redacted]