Drying Procedure for Pipelines

Summary

This utility procedure describes the process for determining the need for drying pipelines after hydrostatic testing, methods of drying, selection of equipment for drying, and drying of Pacific Gas & Electric (Company) pipelines.

Level of Use: Informational Use

Target Audience

Gas operations and maintenance personnel responsible for the design, construction and maintenance of Company-owned or Company-operated gas gathering, transmission and distribution pipelines and station facilities.

Safety

Potential hazards impacting the requirements governed by this utility procedure include, but are not limited to, the following conditions:

- High energy level of compressed air contained in compression equipment, pipes, and hoses at high pressure
- Nitrogen used as a super dry vapor or as a testing medium—requires adequate ventilation at the exhaust and sampling point
- Heavy pigs saturated with water and contaminants

Before You Start

Field personnel following this utility procedure must wear the following personnel protective equipment (PPE) at a minimum, in addition to any other PPE as specified in the Code of Safe Practices:

- Hard hat (must be available)
- Traffic vest
- Proper footwear, no sneakers allowed
- Long sleeve shirt
- Long pants
- Gloves (must be available)

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Procedure Steps

1 Determining the Need for Pipeline Drying

1.1 Water content of sales gas must be kept within 7lb/MMSCFD to meet Company sales gas contract obligations.

1.2 After hydrotesting and dewatering, some gas pipe sections may require drying to keep water contents within the acceptable limit and to prevent potential moisture-related problems such as filter saturation, regulator freezing, and hydrate formation when tied-in and operating.

1.3 A thin layer of water left on the surface of the pipe after dewatering or even moisture absorbed into the rust and mill scale can be detrimental to downstream equipment.

1.4 A super dry gas such as nitrogen or dried air can be flowed through the pipeline in combination with foam pigs to absorb, evaporate, and exhaust this moisture.

1.5 Complete the following steps to determine whether drying of the tested pipe section is required:

a. Calculate the amount of water that can be anticipated to be left in the tested pipe section using one of the two equations for new or in-service pipe in Section 1.5.1 below.

b. Compute the equilibrium moisture content of natural gas following Company requirements as stated in Section 1.5.2 below.

c. Determine whether drying is required by using the criteria for drying requirements in Section 1.5.3 below.

1.5 (Continued)

1. **Calculate the amount of water left in the tested pipe section.**

Use the following equations to calculate the amount of water left in the tested pipe section, Mw (lb/MMSCF). Use Equation 1 for New Pipe and Equation 2 for pipe that has previously been in-service:

Equation 1 (New Pipe)

$$Mw = \frac{7{,}350{,}000}{D^2 P \left(L_1 / L_2\right)}$$

Equation 2 (In-Service Pipe)

$$Mw = \frac{33{,}075{,}000}{D^2 P \left(L_1 / L_2\right)}$$

Where:

Mw = water left in tested pipe section (lb/MMSCF).

D = nominal pipe diameter (inches).

P = pipeline operating pressure (psia = psig + 14.7).

L1 = L2 + L3 = length of tested pipe section plus length of downstream pipeline to be tied-in (ft).

L2 = length of tested pipe section (ft).

L3 = The length of pipe from tie-in point to nearest company or customer facility with meters, regulator, filters, or the likes thereof present.

Assumptions:

- Thickness of water film adhering to inside pipe surface = 0.002 inch for new pipe.
- Thickness of water film adhering to inside pipe surface = 0.009 inch for in-service pipe.
- Density of water = 62.5 lb/ft³.
- Pipeline gas temperature = 60°F.
- Diameter of tested pipe section = diameter of downstream pipeline.

1.5 (Continued)

2. **Compute the equilibrium moisture content of natural gas.**

   Use PG&E Gas Standard N-93, Figure 1, "Equilibrium Moisture Content of Natural Gas," to determine the equilibrium moisture content of natural gas.

3. **Determine drying requirements**

   Use the following criteria to determine if the tested pipe section must be dried.

   a. If the amount of water left in the tested pipe section (as calculated in Section 1.5.1 above) is **greater** than the equilibrium moisture content (as computed in Section 1.5.2 above), then the tested pipe section **must be dried** in accordance with this procedure.

   b. If the amount of water left in the tested pipe section (as calculated in Section 1.5.1 above), is l**ess** than the equilibrium moisture content (as computed in Section 1.5.2 above), then drying is not required. If any of the conditions stated in Section 1.5.4 below exist, **consider drying**.

4. Pipelines with any of the following conditions will be most susceptible to problems caused by moisture and should always be considered for drying.

   Contact Pipeline Engineering for support.

   a. Dewatering pigs are susceptible to water bypass at fittings such as elbows, tees, and taps. The more fittings that are within the hydrotested section of a pipeline, the more likely water will be left.

   b. Hydrotested pipe sections that have large elevation changes are also more susceptible to water bypass.

   c. The closer the hydrotested pipe section is to a downstream regulation station, the greater the need for drying to prevent filter saturation, regulator freezing, or hydrate formation.

   d. Single feed pipelines have a greater chance for detrimental downstream effects from moisture than do those pipelines that will mix with gas from other cross-tied pipelines.

5. As an alternative to the use of equations in Section 1.5.1 above, the following charts (Figures 1 and 2) can be used as conservative guides to determine the need for drying the tested pipe section for any operating pressure. If any of the conditions in Section 1.5.4. exist, **consider drying**.

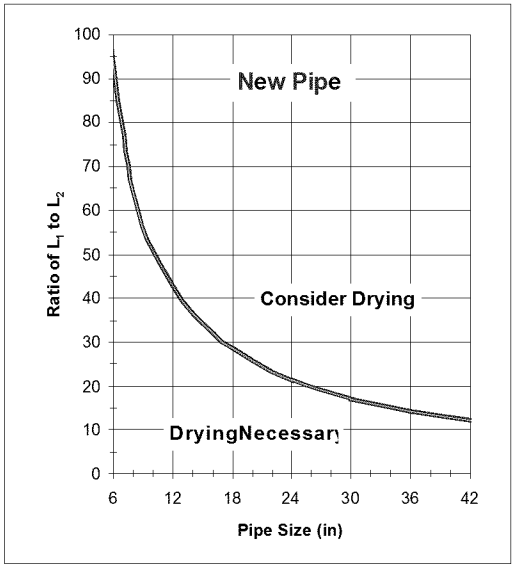

Figure 1. Chart for Drying New Pipe

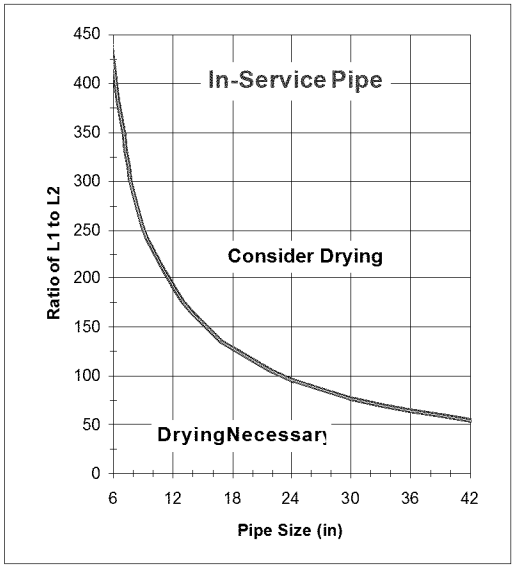

Figure 2. Chart for Drying In-Service Pipe

1.5 (Continued)

Examples for Using Charts for Determining Drying:

(1) If a 100-foot section of new 24-inch pipe is to be tied into a pipeline 1500 feet long, the ratio of L_1/L_2 falls below the curve (Figure 1), so the pipe section must be dried.

(2) If a 100-foot section of in-service 30-inch pipe is to be tied into a pipeline 10,000 feet long, the ratio of L_1/L_2 is above the curve (Figure 2), so drying is not required. However, drying should be considered if any of the conditions in Section 1.5.4 exist.

(3) If 10,000 feet of in-service 24-inch pipe is to be tied into a pipeline 80,000 feet (approximately 15 miles) long, the ratio of L_1/L_2 falls below the curve (Figure 2) and therefore the pipe section must be dried.

2 Selecting Equipment for Pipeline Drying

2.1 A typical setup for pipeline drying equipment is shown on Attachment 1.

2.2 Portable Pig Launchers and Receivers

Portable pig launchers and receivers are attached to the ends of the pipeline to be dried. They allow for the installation of pigs, attachment of compressed dry air or nitrogen equipment, and attachment of drain lines and dust bags. The Company has portable pig launchers and receivers available.

1. Specifications for Company Launchers and Receivers

Sizes and specifications for Company portable pig launchers and receivers are listed in Table 1 below. For other size pipelines, adapters can be designed or pig launchers and receivers can be rented. Contact Pipeline Engineering for support.

2.2.1 (Continued)

Table 1. Specifications for Company Portable Launchers and Receivers

Pipeline Size (in)	Launcher Inlet (in)	Receiver Vent (in)	Barrel Size (in)	Maximum Pressure (psig)
6	2	2	8	140
8	2	4	10	140
10	3	4	12	140
12	3	6	16	140
16	4	6	20	140
20	4	6	24	140
22	6	10	42	125
24	6	10	42	125
30	6	10	42	125
34	6	10	42	125
36	6	10	42	125

WARNING

Do not exceed the pressure rating of the portable launchers or receivers.

2. Portable pig launchers and receivers for 6-inch through 20-inch pipelines are available in sets. They have been built per PG&E Drawing 3803834. These launchers and receivers must not be modified. These launchers have isolation and kicker valves to enable running multiple consecutive pigs.

3. Portable pig launchers and receivers for 24-inch, 34-inch, and 36-inch pipelines use the 42-inch barrel launcher and receiver set. Flanged adapters are fitted to accommodate the 24-inch, 30-inch, 34-inch, and 36-inch pipelines. These launchers do not have isolation valves. More adapters may be built to accommodate other sizes of pipelines. Contact Pipeline Engineering for support.

4. PG&E's portable pig launchers and receivers are stored at the GC Gas yard in Antioch and can be reserved. They will be inspected for wear and damage when reserved, and again when returned. Ensure they are cleaned before returning.

5. Portable pig launchers and receivers are also available from several rental companies. All manufacturer specifications and instructions must be followed. Contact Pipeline Engineering personnel for support.

2.2 (Continued)

6. Attach portable pig launchers and receivers by welding them to the ends of the pipeline section to be dried. Weld the launchers and receivers in accordance with Gas Standard D-22, and visually inspect the launchers and receivers in accordance with Gas Standard D-40.

2.3 Using Compressed Air for Drying

1. Compressed air is convenient for absorption drying and can also be used for evaporative drying. If dry air is used for evaporative drying, the same air compressor(s) can usually be used to run the absorption drying pigs.

CAUTION

Flowing air at a temperature exceeding 180°F may damage the pipeline coatings.

2. Add a desiccant dryer (such as the Pneumatic Products CHA or Quincy Compressor QDTH dryers) between the air compressor and the pig launcher to dry the air for evaporative drying. The desiccant dryer must have the capacity to dry air to a dew point of -80°F at the vapor flow rates listed in Table 3.

3. Several rental companies (such as Holt Equipment) can arrange for compatible air compressors, desiccant dryers, and hoses. Refer to instructions provided by the rental company for equipment setup and operation.

2.4 Using Nitrogen for Evaporative Drying

CAUTION

Flowing Nitrogen at a temperature less than 20°F or greater than 180°F may damage pipeline coatings.

WARNING

Operating and working around Nitrogen supply equipment requires special PPE. Responsible injection equipment personnel must tailboard all personnel about these requirements.

2.4 (Continued)

1. Nitrogen is also an effective vapor for evaporative drying. The Company's liquefied natural gas (LNG) peak shaving personnel can deliver and inject nitrogen. Peak shaving personnel can also assist in defining, implementing, and managing the drying process. Contact peak shaving responsible personnel to establish the cost and availability for using the peak shaving equipment as a nitrogen supply and also to develop a response plan and define the resources needed from construction and operations personnel.

2. Several gas supply companies (such as Praxair or Air Liquide) can also deliver and inject nitrogen.

2.5 Determining the Type and Number of Pigs Needed for Drying

1. Plan the type and number of each pig needed for drying the pipe section, as presented in Table 2 below. For example, to complete both absorption and evaporative drying for a 6-mile section of hydrotested pipeline, at least 43 total Swab Pigs and 6 total Scraper Pigs should be acquired. The actual number of pigs needed may vary depending on the number of fittings and elevation changes in the pipeline section.

Table 2. Type and number of pigs required for drying

Pipeline Section Length (miles)	Absorption Drying		Evaporative Drying	
	Swab Pigs	Scraper Pigs	Swab Pigs	Scraper Pigs
0-1	3	0	6	3
1-2	3 / mile	0	3 / mile + 3	3
2-3	3 / mile	0	3 / mile + 3	3
3-4	3 / mile	0	4 / mile + 1	1 / mile
>4	3 / mile	0	4 / mile + 1	1 / mile

2. Use pigs made from the lightest density foam as appropriate for the length of pipe according to the pig manufacture's recommendations. These pigs are designed to operate only in a single diameter pipeline, and most foam pigs are designed to be run through the length of pipe only once.

CAUTION

Form pigs can be heavy, especially when saturated. Lifting equipment must be available to assist with loading and removing the pigs.

2.5 (Continued)

3. While running pigs in a pipeline, a target speed of 5 feet per second (3.4 mph) should be maintained. The pressure differential and flow rate needed to push a pig largely depends on the size of the pipeline. Pig weights, grade changes, elbows, valves, liquids, scale, and debris can alter the differential pressure and air flow rate needed to maintain the pig run speed. Typical flow rates and differential pressures for running foam pigs in standard pipe sizes are listed in Table 3 below:

Table 3. Typical flow rates and differential pressures for running foam pigs

Pipeline Size (in)	Pig Run Speed (ft/sec)	Differential Pressure (psi)	Air Flow Rate (cfm)
6	5.0	75	60
8	5.0	65	104
10	5.0	50	164
12	5.0	40	236
16	5.0	30	381
20	5.0	20	606
24	5.0	15	884
30	5.0	10	1400
36	5.0	7	2033
42	5.0	5	2784

4. If running multiple consecutive pigs, space out pigs by a mile (or approximately one pig every 20 minutes). Do not exceed launcher pressure limitation when running multiple pigs.

5. Before disposing of used foam pigs, first check each pig for signs of oily residue. If oily residue is found, dispose of as an oily solid. If no oily residue is found, dispose of the pig as common trash.

2.6 Pressure Gauges

Ensure appropriate pressure gauges are available for use with the launcher and receiver. Since there is no means of tracking the actual speed of the pigs, the driving differential pressure needs to be monitored. Note the duration of each pig run and adjust the differential pressure to achieve ideal run speeds. Digital pressure gauges with a range of 0-100 psig are recommended.

2.7 Dust Bags

1. Dust bags (such as Inline Services, Inc., Pigging Dust Bags) should be used on all drying jobs. As the pipeline dries and is scraped, a large amount of the dirt, rust, and mill scale can be collected and pushed by the pigs.

CAUTION

When a pig comes into the receiver and the driving differential pressure surges out through the vent, the debris is rapidly exhausted and my hurl projectiles and form a hazardous dust cloud.

2. Attach dust bags to the receiver vent or other portion of the receiver where the flow is exiting.

3. Change dust bags if they are full or torn.

4. Before disposing of used dust bags, first check each dust bag for signs of oily residue. If oily residue is found, dispose of as an oily solid. If no oily residue is found, dispose of the dust bag as common trash.

2.8 Dew Point Meter

Utilize either an electronic dew point meter (such as the Extech RH300 or Kestrel 300) or stain tubes to measure the dew point temperature during pipeline drying. Refer to UO Guideline G14362 for operating instructions.

3 Absorption Drying Procedure

3.1 For effective and efficient drying, the dewatering process needs to continue until all standing water has been removed from the pipe as well as from taps and branches. When the dewatering process is complete, a thin layer of moisture will still be left on the pipeline wall. Most of this moisture can be dried by absorbing it into foam swab pigs.

3.2 Begin the absorption drying process by setting up the equipment as shown on Attachment 1:

a. Start with all valves on the launcher closed.

b. Reset the Pig Indicators on the launcher and receiver.

c. Ensure the pig snubber is in place in the receiver.

d. Ensure any valves on the receiver vent are open and a dust bag is securely in place.

3.2 (Continued)

e. Close the Drain Valve on the receiver.

3.3 Install a pig in the launcher by completing the following steps:

1. Blow down the launcher to 0 psig. For the first pig, the line will already be depressurized.

a. If the launcher does not have an isolation valve:

(1) Shut down the air compressor.

(2) Slowly open the blow-off(s) on the launcher.

(3) Blow down the entire pipeline.

b. If the launcher has an isolation valve:

(1) Close the isolation and kicker valves.

(2) Slowly open the blow-off valve to blow down the launcher barrel.

2. Open the launcher door and install a pig, nose first, until the nose is in full contact with the reducer.

CAUTION

If the door has Cam Lock levers, be sure the Cam Lock levers are in the unlocked position before removing the bolts.

a. If the launcher door has Cam Lock levers:

(1) Move the Cam Lock levers into the unlocked position.

(2) Unlock all levers before removing the bolts.

(3) Remove the locking bolts and open the door.

3.3 (Continued)

3. Close and securely fasten the launcher door. Make sure all locking levers are in the fully locked position.

   a. If the launcher door has Cam Lock levers:

      (1) Close the door and install the locking bolts.

      (2) Move the Cam Lock levers into the locked position.

4. If the launcher has an isolation valve and air is flowing through the pipeline:

   a. Close the blow-off valve.

   b. Slowly open the Kicker Valve to pressurize the launcher barrel.

   c. When the barrel is at the flow pressure, close the kicker valve.

   d. Open the Isolation Valve.

   e. Slowly open the Kicker Valve until the pig is launched as indicated by the Pig Indicator.

      (1) The Throttle Valve may need to be temporarily closed to get the pig launched.

   f. After the pig is launched, close the kicker valve.

   g. Close the Isolation Valve.

   h. Adjust the Throttle Valve as necessary to maintain the desired flow rate.

5. If the launcher has an isolation valve, but air is not flowing:

   a. Open the throttle, isolation, and kicker valves.

   b. Start up the air compressor.

   c. Slowly close the throttle valve until the pig is launched as indicated by the pig indicator.

   d. Close the isolation and kicker valves.

   e. Adjust the Throttle Valve until the desired flow rate is achieved in the pipeline.

6. If the launcher does not have an Isolation Valve:

   a. Close the blow-off(s) on the launcher.

3.3 (Continued)

b. Start up the air compressor to launch the pig.

c. Adjust the pressure until the desired flow rate is achieved in the pipeline.

7. Reset the pig indicator on the launcher.

3.4 When a pig reaches the receiver, stop the flow in the line.

1. Since the venting exhaust air will have an assortment of pressure surges as the pig negotiates through various bends and grade changes, before stopping the flow confirm that the pig is actually in the receiver. (A tripped pig indicator or the noises of the pig hitting the snubber are evidence that the pig is in the receiver.)

2. The differential pressure that drove the pig into the receiver will dissipate through the vent. Allow the pressure to dissipate completely until the pressure gauge is reading 0 psig and no flow is coming out of the receiver vent.

WARNING

Ensure that all personnel and the general public in the vicinity of the receiver are protected from the noise associated with the sudden release of the differential pressure.

Ensure that all personnel observing the pig receiving do not lean upon, position any part of their body under or set tools on top of the receiver vessel and associated piping until the pig is received and energy dissipated.

3.5 If other pigs are following in the pipeline, they may create differential pressures and therefore might move at any time. Before opening the receiver door, an isolation valve on the receiver must be closed or a pig stop safety mechanism must be pinned securely in place.

1. To securely pin the pig stop mechanism on the Company portable pig receivers, complete the following steps:

a. Verify that the pressure gauge is reading 0 psig and no flow is coming out of the receiver vent or drain.

b. Remove the side caps from the receiver pup.

c. Install the pig stop bar and pin it in place.

3.5 (Continued)

d. Keep the pig stop in place until after the pig is removed and the receiver door is closed and secured.

3.6 Open the receiver door and remove the pig.

CAUTION

If the door has Cam Lock levers, be sure the Cam Lock levers are in the unlocked position before removing the bolts.

1. Take out the snubber and remove the pig.
2. Drain any liquids and clean out any debris from the receiver.
3. Put the snubber back into receiver.
4. Close and securely fasten the receiver door making sure that all of the locking levers are in the locked position.
5. Remove the pig stop bar (if used) and replace the caps.
6. Check the dust bag and replace if full or torn.
7. Reset the Pig Indicator.

3.7 Resume air flow at the desired flow rate.

3.8 Continue to launch and remove pigs by repeating steps 3.3 through 3.7 until a foam pig is received in a dust-dry condition, or there are only enough unused pigs remaining for evaporative drying. Periodically alternate scraper pigs in with the swab pigs in the same ratio as presented in Table 2 in Section 2.5.1 above.

4 Evaporative Drying Procedure

4.1 After a foam pig is removed from the line in a dust-dry condition, moisture may still remain absorbed in the rust and mill scale on the inside of the pipe. Continue to dry the pipeline following the evaporative drying procedure in this section, following the steps below, until the dew point temperature of the exhausting vapor is between -20° F and -40° F. Consult with Pipeline Engineering for guidance on the required dew point temperature for the job.

4.2 Add a desiccant air drier between the air compressor and the launcher, or switch to a nitrogen source, to generate a super dry vapor for evaporative drying.

4 (Continued)

WARNING

If nitrogen is used as the super dry vapor, adequate ventilation must be available at the exhaust and sampling points for all personnel and the general public.

4.3 Check the temperature and dew point of the super dry vapor entering the pipe to ensure it is less than 180°F with a dew point of -60°F or less.

4.4 Continuously monitor the dew point temperature during evaporative drying. Take dew point temperature measurements from a sampling point or isolated vent to avoid water, dust, or debris that could foul the measuring tool.

4.5 Launch and receive pigs as described in steps 3.3 through 3.7 of the absorption drying section of this utility procedure. Periodically alternate scraper pigs in with the swab pigs in the same ratio as presented in Table 2 in Section 2.5.1 above.

1. After a few dry pigs are received, the dew point temperature should begin to drop.

NOTE

It is not uncommon for the dew point to temporarily increase as a pig is being received.

2. If a swab pig is run with no appreciable change in the dew point temperature, a scraper pig may produce better results.

3. As the dew point temperature drops, continue the flow of the super dry vapor without running a pig. Launch another pig when the rate of the falling dew point tapers off.

4. To facilitate drying when there is not a pig in the line, the flow rate of the super dry vapor can be increased. Increasing temperature or decreasing pressure, or both, will also facilitate drying.

4.6 Individually open each tap and branch line and flow the super dry vapor to dry.

4.7 Partially operate all valves to ensure all water has been removed from the body cavities.

4.8 When evaporative drying is complete, disconnect and remove the pipeline drying equipment and cap all open pipe ends.

5 Other Drying Methods

5.1 Other pipeline drying methods such as methanol, vacuum, or internal sand blasting should only be used after consulting with Pipeline Engineering personnel.

END of Instructions

Definitions

Absorption drying: A method by which the thin layer of water left on the pipe surface is removed by absorbing it into the foam pigs.

Dew point: The temperature below which the water vapor of humid air at a constant barometric pressure will condense into liquid water. Condensed water is called dew when it forms on a solid surface.

Evaporative drying: A method by which the thin layer of water left on the pipe surface is removed by super dry air or nitrogen.

Implementation Responsibilities

The Company supervisor in charge of the test is responsible for overseeing the implementation of this procedure.

The Subject Matter Expert (SME), GT M&C supervisor, distribution T&R supervisor responsible for testing pipelines, gas engineering personnel, and gas mapping personnel must facilitate implementation of this procedure.

Governing Document

Utility Standard TD-4137S, "Pipeline Test Requirements" governs this document.

Compliance Requirement/ Regulatory Commitment

49 CFR192.3 "Definitions"

49 CFR192.503 "General requirements"

49 CRF 192.505 "Strength test requirements for steel pipeline to operate at a hoop stress of 30 percent or more of SMYS"

CPUC's General Order No. 112-E, "State of California Rules Governing Design, Construction, Testing, Operation, and Maintenance of Gas Gathering, Transmission, and Distribution Piping Systems"

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Reference Documents	**Developmental References**: Utility Procedure TD-4137P-01, "Test Procedure for New Pipelines" Utility Procedure TD-4137P-02, "Test Procedure for Existing Pipelines" Numbered Document A-34, "Piping Design and Test Requirements" **Supplemental References**: Gas Standard A-34.1 General Requirements Work Reportable to California Public Utility Commission Gas Rule 21-"Transportation of Natural Gas, Section C.6, Water Vapor" Utility Standard TD-4580S, "Natural Gas Quality" Utility Standard N-93, "Equilibrium Moisture Content of Natural Gas" Utility Guideline G14362, "Maintenance and Operation of Water Dew Point Instruments for Natural Gas Pipelines"
Appendices	NA
Attachments	TD-4137P-03 Attachment 1, "Pipeline Drying Equipment Setup"
Document Recision	This document supersedes and cancels Numbered Document A-37 "Hydrostatic Testing Procedures," Revision 0, issued on November 22, 2004. This procedure includes procedural steps previously included in Numbered Document A-37.
Approved By	William Mojica, Manager
Document Owner	Redacted, Principal Gas Engineer
Document Contact	Redacted, Supervisor

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Revision Notes

Where?	What Changed?
NA	This is a new procedure.