PURGING

These procedures cover the purging of air or natural gas from transmission and distribution facilities. They describe the manner in which the facilities are to be purged, how to determine when the purge is completed, and items to be considered prior to and during purging.

Purging is necessary when:

1. New or existing facilities are brought into service.

2. Existing facilities are temporarily taken out of service and the removal of natural gas is necessary.

3. Lines are abandoned.

The requirements for purging as stated by General Order 112-C are as follows:

Section 192.629 Purging of pipelines

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

Section 192.727 Abandonment or inactivation of facilities

(a) Each operator shall provide in its operating and maintenance plan for abandonment or deactivation of pipelines, including provisions for meeting each of the requirements of this section.

(b) Each pipeline abandoned in place must be disconnected from all sources and supplies of gas, purged of gas, and the ends sealed. However, the pipeline needs not be purged when the volume of gas is so small that there is no potential hazard.

(c) Except for service lines, each inactive pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas, purged of gas, and the ends sealed.

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1	1-10-77	CHGED GAS STD REF. ON PG 5 FROM M-15 [redacted]					
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PIPING - DATA SHEET

PROCEDURE FOR PURGING GAS TRANSMISSION & DISTRIBUTION FACILITIES

GAS STANDARD

PACIFIC GAS AND ELECTRIC COMPANY

SUPERSEDES

SUPERSEDED BY

SHEET No. 1 OF 13 SHEETS

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However, the pipeline needs not be purged when the volume of gas is so small that there is no potential hazard.

(e) If air is used for purging, the operator shall insure that a combustible mixture is not present after purging.

I. Considerations Prior to Purging

When purging is necessary, the air or gas must be evacuated from all sections of the piping system.. Branches and services must be individually purged.

Prior to the purging of all but simple piping systems, a written plan should be prepared and reviewed with the Company personnel involved. The following items should be discussed:

1. The extent of the facility to be purged and points of isolation.
2. The purging medium to be used.
3. The sequence of operation and assignment of personnel.
4. Safe working practices (especially around plastic pipe).
5. Means of communication during purge.
6. Means of determining end of purge at vent points.
7. Emergency procedures (fire).
8. Notification of governmental authorities if required (police, fire, air pollution, noise abatement).
9. Back up provisions, in case of unanticipated occurrences (i.e. compressor failure, insufficient supply of purging gas, etc.).

II. Purging Air Out of Facilities to Be Placed in Service

A. Purging Services

Service installations may be purged by opening the riser valve after the service tee has been tapped. Care must be taken to blow gas away from structures by connecting a meter bend or street ell to the riser valve and pointing stream of gas in a safe direction. The valve should be opened slowly to the full open position; no person or object should be in the exhaust stream area. The operator shall hold the wrench and keep it in contact with the valve stem at all times. Care must also be taken that no source

of ignition is present in the area. A sufficient amount of gas should be blown to atmosphere to insure that all air is removed from the line. Service lines should be purged immediately after the service tee has been tapped and gas is in the line.

B. Purging of Pipelines (Mains 10" Diameter and Less)

Small diameter mains should be purged of air by injecting gas at high enough velocities to create a minimum lineal flow of 100 feet/minute within the pipeline*. This flow rate will maintain a turbulent interface between the natural gas and air. It will also minimize:

1. Mixing of air and gas in the pipeline to limit the extent of the combustible mixture, and

2. The duration of the purge.

All parts of the piping system must be purged completely and air-natural gas mixtures must be vented safely. Purging should progress without interruption.

In order to determine if the line has been adequately purged, a small amount of the vented gas can be blown into a bucket of soapy water with a hose. Move the bucket to a safe location, stand up wind, and ignite the gas contained in the bubbles. If the gas burns with an orange or yellow flame, the purge is complete. If the gas burns with a blue flame then there is air present and further purging is necessary. A portable combustible gas indicator (Gas Standard M-53) set on percent gas scale can also be used. The reading must indicate 100% gas.

Appendix A shows a sample procedure for purging air from a simple distribution system.

C. Purging Pipelines (Larger than 10" Diameter)

For mains greater than 10 inches diameter, it is desirable to separate the air from the natural gas with a slug of nitrogen. This technique prevents mixing which otherwise would be accelerated due to the greater cross-sectional area of the large diameter pipe. Section IV of these instructions describes purging with a slug of nitrogen.

When the use of nitrogen is impractical, pipelines with a diameter greater than 10" are purged of air by injecting natural gas into the line at high velocities. A minimum lineal velocity of 100 feet/minute along the pipeline insures a turbulent interface between the natural gas and air*. The flow should be uninterrupted until

*For other than low pressure systems, a cracked main line valve will create a minimum lineal velocity of 100 feet/minute within the pipeline. When purging low pressure systems, the available injection pressure and the physical characteristics must be examined to determine if the 100 feet/minute velocity can be achieved.

the purge is complete. Continuous turbulent flow minimizes mixing and also the extent of the flammable mixture within the pipeline. Appendix B states the procedure for the Displacement of Air with Combustible Gas.

Check the vented gas with the soapy water test or a combustible gas indicator to determine when the purge is complete.

III. Purging Natural Gas Out of Existing Facilities

A. Purging of Pipelines (10" Diameter and Less)

Lines 10 inches in diameter and smaller are purged of natural gas using a supply of air. An uninterrupted flow of air must be injected into the pipeline with a minimum lineal velocity of 100 feet/minute. All parts of the piping system must be purged completely and the air-natural gas mixture must be vented safely.

The disposal of large volumes of natural gas into the atmosphere should be minimized as far as practical by transferring as much as possible to adjacent systems.

It is essential that vented natural gas be diffused into the air without hazard to Company personnel, the general public or property. Valved vertical vent stacks should be used to keep the natural gas out of the work area and to blow it in a safe direction. Buildings, overhead lines, aircraft landing patterns and other obstructions or sources of ignition should be considered when determining the location for venting the gas (See Section 20 of the Accident Prevention Rule Book).

Consideration must also be given to public relations with regard to objectionable noise and odor as well as to any applicable state and local noise and pollution abatement requirements. Such considerations may include the notification of residents in close proximity to the blowdown operations, the use of noise suppressors, reduction of line pressure, reduced rate of venting, etc.

Gas must be evacuated from all portions of the pipeline. The straight through section should be purged first, then each lateral.

The following methods can be used to determine the absence of natural gas:

1. Use of a combustible gas indicator.

2. Blowing a small portion of the vented gases through soapy water, and attempting to ignite the gas entrapped in the bubbles at a safe location. If the gas ignites, continue the purge.

Section 192.727 of General Order 112-C states that abandoned facilities do not have to be purged when the volume of gas is so small that there is no potential for hazard. Company policy requires that all sections of abandoned main be purged (For abandonment procedures, refer to Standard Practice 463-2).

B. Purging Pipelines (10" Diameter and Larger)

For mains greater than 10 inches diameter, it is desirable to separate the natural gas from the air with a slug of nitrogen. This technique prevents mixing which otherwise would be accelerated due to the greater cross-sectional area of the large diameter pipe. Section IV of these instructions describes purging with a slug of nitrogen.

When it is impractical to use nitrogen, pipelines with a diameter greater than 10 inches can be purged of natural gas with air. A minimum lineal velocity of 100 feet/minute should be maintained in the pipeline. The purging air can be supplied by a compressor* (or bank of compressors) or a Lamb Air Mover. Gas Standard A-38.1 describes the use of the Lamb Air Mover.

Gas must be evacuated from all portions of the pipeline. Purging operations should not be interrupted until all gas is removed from the system. When venting natural gas to the atmosphere, the safety precautions mentioned in Section III A shall be observed.

The following methods can be used to determine the absence of natural gas:

1. Use of a combustible gas indicator.

2. Blowing a small portion of the vented gases through soapy water and attempting to ignite the gas entrapped in the bubbles at a safe location. If the gas does not ignite, then the purge is completed.

IV. Purging with Nitrogen

A. Purging with a Slug of Nitrogen

In order to prevent explosive mixtures when purging long, large diameter lines, a slug of nitrogen can be injected into line prior to the purging medium. The nitrogen will mix with the air and the gas, but as long as sufficient nitrogen is injected, an explosive mixture will not occur. The graph in Appendix D shows the proper amount of nitrogen to be used when purging various lenghts of 12" 20" and 34" pipelines.

*A standard PGandE compressor is rated for 150 CFM. It will provide the minimum flow rate for pipelines up to 16 inches in diameter. Air compressors with 250 CFM and 650 CFM capacities can also be obtained. Appendix C states the flow-pressure drop relationships for air through flexible hose and orifices.

Following are additional facts regarding inert slug purging which have been determined experimentally:

(1) Purge velocity is extremely important. Avoid a slow purge. Velocities less than 100 feet per minute in large diameter pipe allow stratification between heavier and lighter gases.

(2) The amount of nitrogen necessary to purge short lengths (500 feet or less) of large-diameter pipe satisfactorily at practical purge velocities exceeds the volume of the line.

(3) Changes in horizontal or vertical direction because of elbows or return bends do not destroy the nitrogen slug.

(4) A temperature variation in the order of 20°F has no effect on mixing of the nitrogen slug with combustible gas or air.

(5) The same amount of inert gas, as a slug, may be used if either combustible gas or air is being purged from a line.

(6) Turbulence, even if it causes mixing, is much less the cause of deterioration of the slug than is stratification.

(7) A delay of approximately three minutes between the addition of the inert gas and the injection of air or combustible gas will destroy the slug.

B. Purging with 100% Nitrogen

When it is suspected that hydrate formations are in the pipeline, natural gas must be purged with 100% Nitrogen. After the natural gas has been purged, the Nitrogen should be left in the line until all of the hydrates have sublimated. Hydrate sublimation can be accelerated by the injection of methanol.

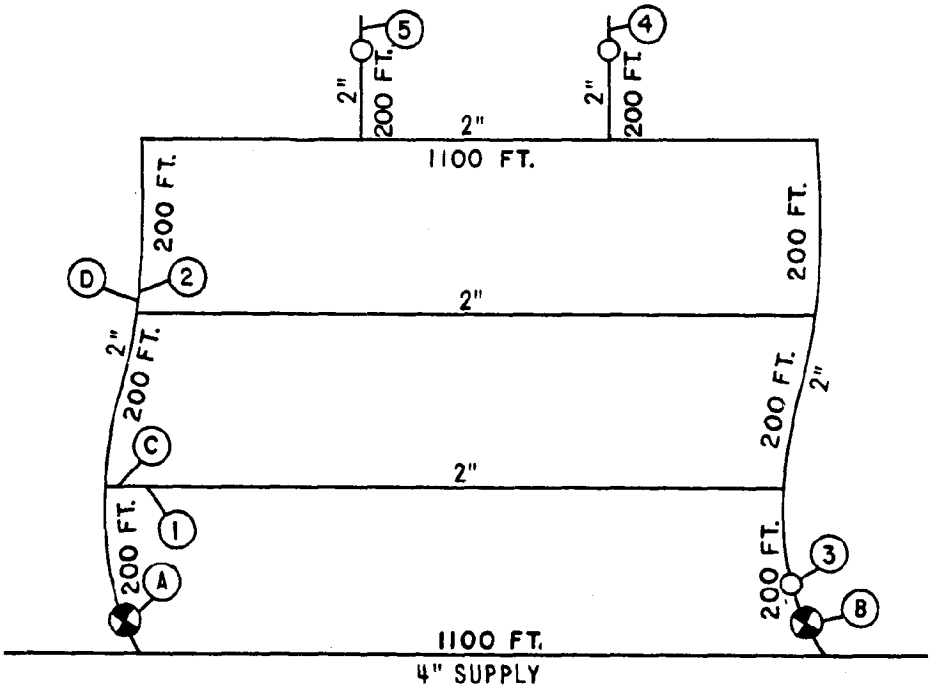
When it is suspected that natural gas may be entrained in liquids in the pipeline, 100% Nitrogen should also be considered. The exclusion of air in the purging medium prevents the formation of an explosive mixture subsequent to the passage of the purged gas through the pipeline.

Consideration should also be given to pigging a line to remove entrained liquids if they are known to be present.

NOTE: One cylinder of nitrogen at 2200 psig contains 220 cubic feet of gas at atmospheric pressure. Figure 5 in Appendix E, shows how much nitrogen remains in a partially used cylinder.

APPENDIX A

SAMPLE PROCEDURE FOR THE PURGE OF MAIN INSTALLED FOR NEW SUBDIVISION 1



Distribution Main System for New Subdivision

PROCEDURE

(1) Close off 2" lines at C and D, isolating by pinch, fitting, valve or other means.
(2) Open vent at 1.
(3) Open valve A. Leave valve B closed.
(4) Close vent at 1 when 100% natural gas is detected.
(5) Open vent at 2. Close when 100% natural gas is detected.
(6) Open vent at 3. Close when 100% natural gas is detected.
(7) Open vent at 4. Close when 100% natural gas is detected.
(8) Open vent at 5. Close when 100% natural gas is detected.
(9) Purge all service lines installed.
(10) Open isolation points C and D.
(11) Open valve B.
(12) Stub services do not have to be purged.

[1] "Purging Principles and Practices", American Gas Association, Cat. No. XK0775, 1975.

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APPENDIX B

LARGE DIAMETER PIPE

The following is an excerpt from "Purging Principles and Practices", American Gas Association, Catalog No. XK0775, 1975.

As pipe diameter increases, the length of flammable mixture increases, and it becomes a more important consideration during purging operations.

Purging procedures for large diameter lines to provide means of removing all of the air by direct displacement with a combustible gas and displacement of a combustible gas with air follows.

Procedure for Displacement of Air with Combustible Gas.

When purging with combustible gas into a pipeline containing air, a minimum flow velocity of 100 linear feet per minute or greater is recommended. The combustible gas flow should be continued without interruption until the vented combustible gas is free from air.

The following procedure, often called the Inlet Control Procedure, should be used for purging pipe of known size and length, which is dry and has a connection for a pressure gauge at the inlet end of the section to be purged:

(1) Determine the blowoff size, pipeline size, and the length of section to be purged.

(2) Obtain the inlet control pressure from Table 8-1.

(3) Install on the section to be purged a pressure gauge, which is accurate and readable to within 1 psi, so that the inlet pressure can be observed. (Note: The gauge should be connected through several feet of flexible tubing to eliminate excessive vibration).

(4) Open the blowoff valve at the downstream end of the section to be purged. Downstream blowoff valves should always be in the fully open position.

(5) Start purging by bringing the inlet pressure quickly to the determined pressure and maintain the pressure for a period of time equal to two minutes for each mile of pipe in the section being purged. (See Table 8-1).

(6) At the end of the determined time (two minutes per mile), the inlet gas flow is shut off; however, the venting downstream blowoff should remain open for an additional minute per mile of pipe being purged. Verify completeness of purge. The use of a combustible gas indicator provides a means of analyzing the gas-air mixture throughout the purging operation and also of confirming the gas to be free of air.

(7) Close the blowoff valve and return the pipeline to service.

TABLE 8-1 [1]

Purging Data for Inlet Control Procedure
Minimum Inlet Pressures-PSIG
(By Line Size)

LENGTH OF PIPELINE (MILES)	2" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)		4" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)				6" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)					
	4"	6"	6	8	10	12	12	16	18	20	22	24
1	14	22	8	8	11	18	6	11	14	21	28	36
2	20	25	12	11	13	20	8	12	15	22	28	36
3	25	28	16	13	15	21	10	13	16	23	29	36
4	29	30	19	16	17	22	11	14	17	23	29	37
5	33	32	22	18	18	23	13	15	18	24	30	37
6	37	35	24	20	20	24	14	16	19	25	30	37
7	40	37	27	22	21	25	16	17	20	25	31	38
8	43	39	29	24	23	26	17	18	20	26	31	38
9	46	41	32	26	24	27	18	19	21	26	31	39
10	49	43	34	28	25	28	20	20	22	27	32	39
11	52	44	36	29	26	29	21	21	23	28	32	39
12	55	46	38	31	28	30	22	22	23	28	33	40
13	57	48	40	32	29	31	23	23	24	29	33	40
14	60	50	41	34	30	32	24	24	25	29	34	40
15	62	51	43	35	31	33	25	24	25	30	34	41

LENGTH OF PIPELINE (MILES)	8" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)			10" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)			12" BLOWOFF VALVE INLET PRESSURE PSIG LINE SIZE (INCHES)
	20	22	24	24	26	30	34
1	9	12	16	8	9	15	13
2	10	13	17	9	10	15	13
3	11	13	18	10	11	16	14
4	12	14	18	11	11	16	14
5	13	15	19	12	12	17	15
6	13	16	19	12	13	17	15
7	14	16	20	13	13	18	15
8	15	17	21	14	14	18	16
9	16	18	21	15	15	19	16
10	17	19	22	15	15	19	17
11	17	19	22	16	16	20	17
12	18	20	23	17	16	20	18
13	19	21	23	17	17	20	18
14	20	21	24	18	17	21	18
15	20	22	24	19	18	21	19

NOTE:
1. Establish pressure from Table 8-1 and maintain for a total time equal to two minutes per mile of pipeline.
2. Add 5 psig to the pressures shown on Table 8-1, if purging is done through a crossover arrangement, and the pressure is measured at the crossover valve.

NOTE: ADD 5 PSI TO THESE PRESSURES IF PURGING TAKES PLACE THROUGH AND PRESSURES ARE READ ON A TIE BETWEEN TWO LINES WHEN THE DIAMETER OF THE TIE IS SMALLER THAN THE LINE SIZE.

Note;
(1) Establish pressure from Table 8-1 and maintain for a total time equal to two minutes per mile of pipeline.
(2) Add 5 psig to the pressures shown on Table 8-1, if purging is done through a crossover arrangement, and the pressure is measured at the crossover valve.

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[1] "Purging Principles and Practices", American Gas Association, Catalog No. XK0775, 1975.

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APPENDIX B

Continued

Example:

A 30" pipe, 13 miles long, is to be placed into service. A 10" blow-down is to be used for venting. Table 8-1 shows that a 30" pipe, 13 miles long, requires a natural gas inlet pressure of 20 psig. The length of time is 13 miles times 2 minutes per mile or 26 minutes. After 26 minutes have elapsed, the inlet valve is closed and venting continues for 13 minutes more, then the vent valve is closed.

APPENDIX C

INJECTION RATES THROUGH HOSES AND ORIFICES

This table is used to determine the pressure required to inject various flow rates of nitrogen or air through different sizes of hoses and orifices. See Gas Standard N-97.4 to convert air injection rates into natural gas injection rates.

Inject Rate CFM	Required Pressure Up Stream of Hose or Orifice, Psi								
	Each 3/4" I.D. 50' Hose	Each 1-1/4" I.D. 50' Hose	Each 2" I.D. 50' Hose	Critical Flow in Orifices					
				3/8"	1/2"	5/8"	7/8"	1-1/8"	1-3/8"
10	3								
20	5								
40	11								
60	18			31					
80	26			47					
100	35	6		65	25				
120	44	8		82	34				
130	49	9		91	40				
140	54	10		98	44				
160	64	12		118	53	27			
200	87	17			71	40			
230	103	21			87	49			
270		26	4		105	60			
320	NOTE:	33	5			75	27		
370		40	7			90	35		
420	Multiple	46	8			105	42		
430		47	9				43	19	
530	Hoses	60	12				60	30	
620		75	16				72	36	
700	Maybe	87	19				85	46	24
720		89	20				90	48	26
830	Used	105	26				105	58	32
900			30					65	37
950	To		31					70	41
1000			32					75	46
1050	Increase		33					77	47
1070			34					80	49
1170	The		38					90	55
1200			39					95	58
1350	Volume		45					108	68
1520			52						79

NOTE: When purging long lengths of small diameter pipe, the pipeline might be more restrictive to flow than the hose or orifice. Therefore, the injection rate will be less than that given in the table. Purging can still continue because the air flow will be turbulent.

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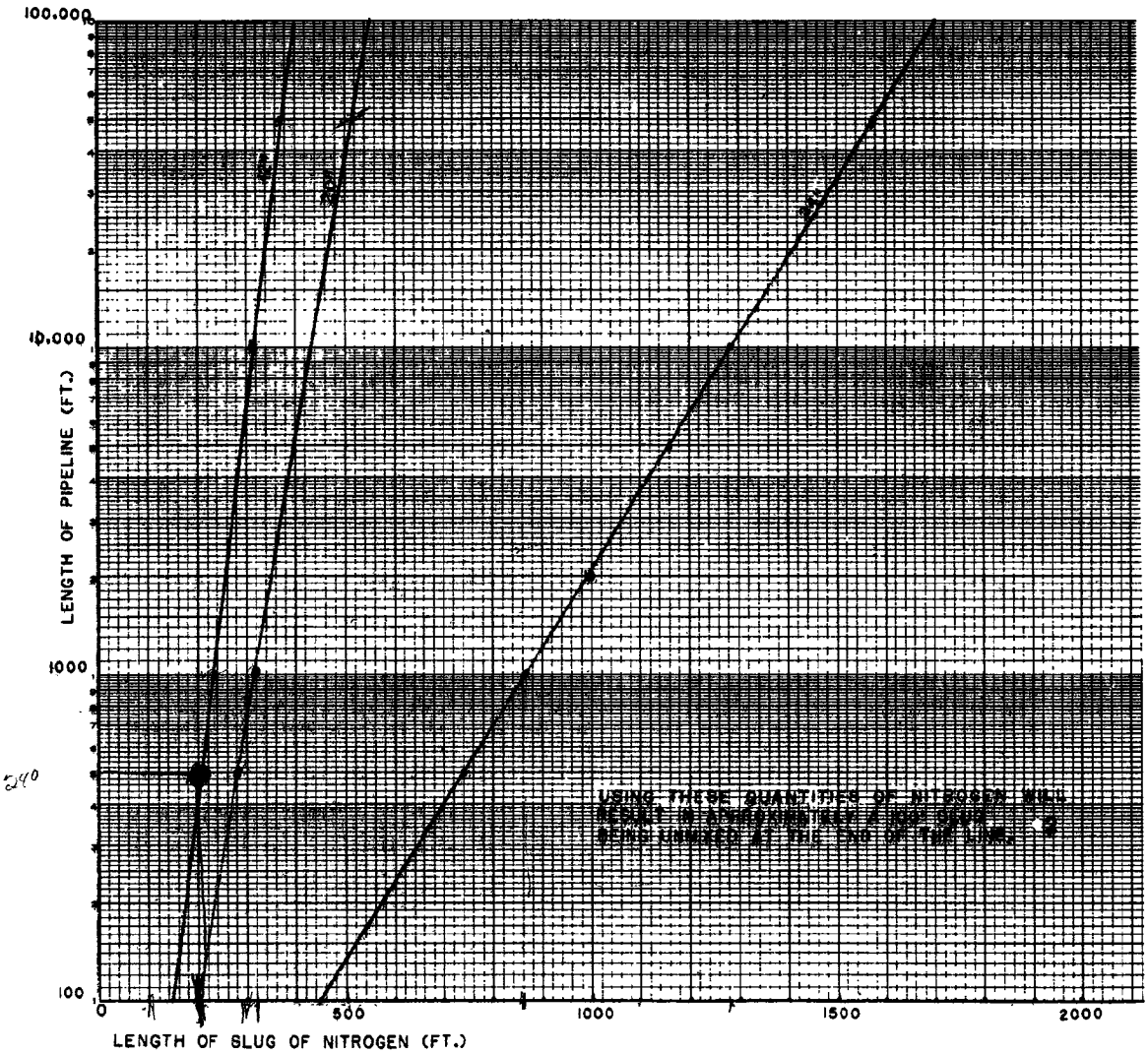
APPENDIX D



1 Per 1975 AGA Purging Principles and Practice.

2 Based on a slug velocity of 100 ft/min along the pipeline.

Quantities of nitrogen to be used when purging with a slug of nitrogen.[1]	PG&E CO. SHEET 12 OF 13 SHEETS	DRAWING NUMBER 086628	REV. 0
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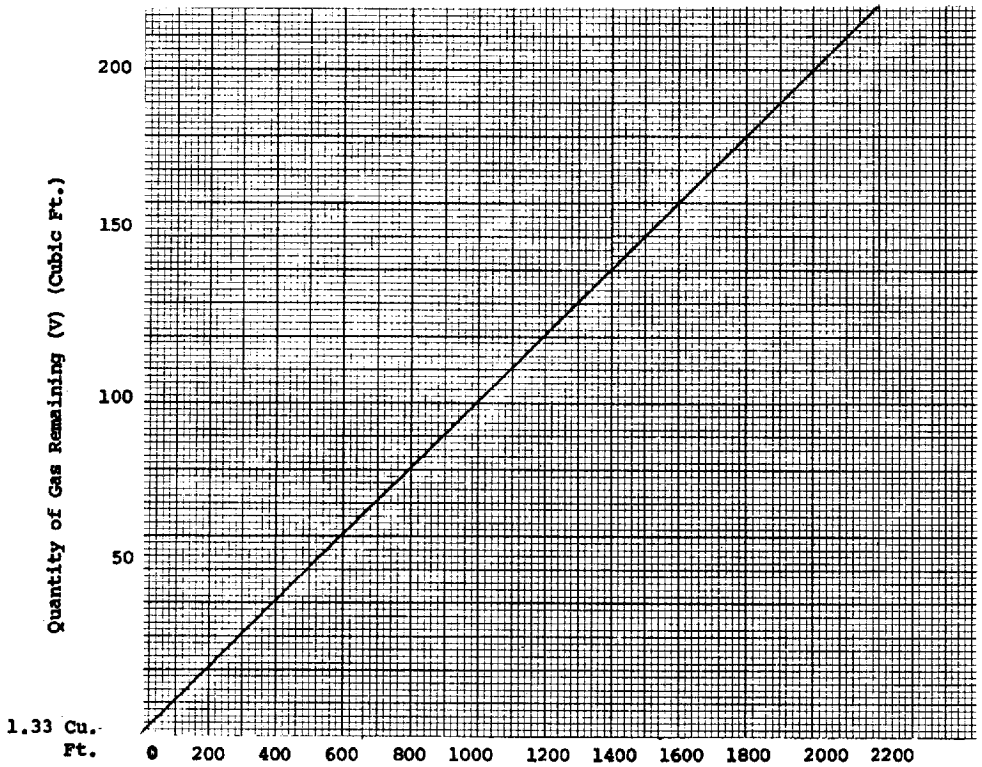
APPENDIX E

Quantity of Nitrogen Gas Remaining in a Standard Cylinder of Nitrogen Gas



$$V = \frac{(P + 14.7)}{2214.7} \times 220 *$$

*One cylinder of nitrogen @ 2200 psig contains 220 cu. ft. @ atmospheric pressure.

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