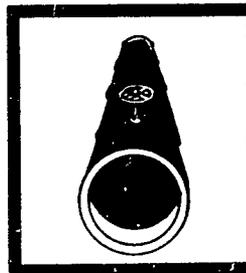
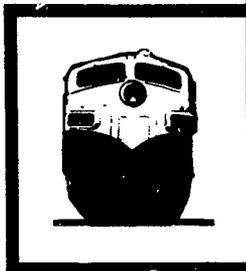
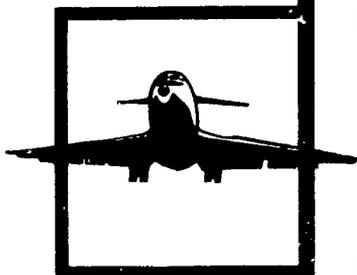


PB82-916901



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

PIPELINE ACCIDENT REPORTS

**BRIEF FORMAT
SUMMARY FORMAT
ISSUE NUMBER 1 -- 1982**

NTSB-PAB-82-1

UNITED STATES GOVERNMENT

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-PAB-82-1		2. Government Accession No. PB82-916901		3. Recipient's Catalog No.																																									
4. Title and Subtitle Pipeline Accident Report - Summary Format, Issue Number 1 1982				5. Report Date January 22, 1982																																									
				6. Performing Organization Code																																									
7. Author(s)				8. Performing Organization Report No.																																									
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594				10. Work Unit No. 3388A																																									
				11. Contract or Grant No.																																									
				13. Type of Report and Period Covered 22 U.S. Pipeline Accidents occurring in 1978, 1979, 1980, and 1981 in Summary Format.																																									
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594				14. Sponsoring Agency Code																																									
15. Supplementary Notes																																													
16. Abstract This publication contains summary reports of selected pipeline accidents, occurring during calendar years of 1978, 1979, 1980, and 1981. The summary reports present basic facts, conditions, circumstances, and probable cause(s) in each instance. File Numbers: <table border="0" style="width: 100%;"> <tr> <td>FTW-78-FP-008</td> <td>FTW-79-FP-002</td> <td>FTW-80-FP-001</td> <td>FTW-81-FP-002</td> </tr> <tr> <td></td> <td>DCA-79-FP-016</td> <td>DCA-80-FP-007</td> <td>FTW-81-FP-003</td> </tr> <tr> <td></td> <td>DCA-79-FP-024</td> <td>ATL-80-FP-001</td> <td>FTW-81-FP-004</td> </tr> <tr> <td></td> <td></td> <td>FTW-80-FP-004</td> <td>FTW-81-FP-005</td> </tr> <tr> <td></td> <td></td> <td>FTW-80-FP-005</td> <td>DCA-81-FP-007</td> </tr> <tr> <td></td> <td></td> <td>FTW-80-FP-006</td> <td>FTW-81-FP-006</td> </tr> <tr> <td></td> <td></td> <td>FTW-80-FP-007</td> <td>FTW-81-FP-007</td> </tr> <tr> <td></td> <td></td> <td>FTW-80-FP-008</td> <td>FTW-81-FP-008</td> </tr> <tr> <td></td> <td></td> <td></td> <td>FTW-81-FP-009</td> </tr> <tr> <td></td> <td></td> <td></td> <td>FTW-81-FP-010</td> </tr> </table>						FTW-78-FP-008	FTW-79-FP-002	FTW-80-FP-001	FTW-81-FP-002		DCA-79-FP-016	DCA-80-FP-007	FTW-81-FP-003		DCA-79-FP-024	ATL-80-FP-001	FTW-81-FP-004			FTW-80-FP-004	FTW-81-FP-005			FTW-80-FP-005	DCA-81-FP-007			FTW-80-FP-006	FTW-81-FP-006			FTW-80-FP-007	FTW-81-FP-007			FTW-80-FP-008	FTW-81-FP-008				FTW-81-FP-009				FTW-81-FP-010
FTW-78-FP-008	FTW-79-FP-002	FTW-80-FP-001	FTW-81-FP-002																																										
	DCA-79-FP-016	DCA-80-FP-007	FTW-81-FP-003																																										
	DCA-79-FP-024	ATL-80-FP-001	FTW-81-FP-004																																										
		FTW-80-FP-004	FTW-81-FP-005																																										
		FTW-80-FP-005	DCA-81-FP-007																																										
		FTW-80-FP-006	FTW-81-FP-006																																										
		FTW-80-FP-007	FTW-81-FP-007																																										
		FTW-80-FP-008	FTW-81-FP-008																																										
			FTW-81-FP-009																																										
			FTW-81-FP-010																																										
17. Key Words excavation damage, odor report, control line, torch-cut flaw, hydraulic overpressure, emergency shutdown, butane, migration, circumferential fracture, anhydrous ammonia, one-call system", asphyxiation, breathing equipment, unrestrained pipe, compression coupling, bypass, propylene, slide gate.				18. Distribution Statement This document is available through the National Technical Information Service, Springfield, Virginia 22161.																																									
19. Security Classification (of this report) UNCLASSIFIED		20. Security Classification (of this page) UNCLASSIFIED		21. No. of Pages 63	22. Price																																								

FOREWORD

The National Transportation Safety Board, in accordance with the provisions of the Independent Safety Board Act of 1974, has determined the probable cause of the accidents reported herein.

This publication contains the reports of 42 pipeline accidents arranged in chronological order.

The enclosed briefs are the reports of the National Transportation Safety Board and are thereby subject to the limitations of 49 USC 1903(c):

"No part of any report or reports of the Board, relating to any accident or the investigation thereof, shall be admitted as evidence or used in any suit or action for damages growing out of any matter mentioned in such report or reports."

For those readers who wish more detailed information, the original factual reports are on file in the Washington, D.C., headquarters of the National Transportation Safety Board where they may be examined. These reports will be reproduced for a fee covering reproduction cost and postage. Orders for material also are subject to a user charge by the Board for special services, and such charge will be included in the bill.

Requests for copies of the factual reports should be forwarded to:

**National Transportation Safety Board
Public Inquiries Section
Washington, D.C. 20594**

TABLE OF CONTENTS

	PAGE
FOREWORD	ii
TABLE OF CONTENTS	iii
EXPLANATORY NOTES	1
ALPHABETICAL LIST OF ACCIDENTS	3
REPORTS OF ACCIDENTS	5

EXPLANATORY NOTES

Scope

The accidents included herein are those occurrences incidental to pipeline operations which fall within the scope of Section 304 of the Independent Safety Board Act of 1974, as amended. As provided in this Section, the Board shall investigate and determine facts, conditions, circumstances, and the probable cause of any pipeline accident in which there is a fatality, or substantial property damage.

Fatality

"Fatality" means the death of a person either at the time a pipeline accident occurs or within 60 days thereafter.

Substantial Damage

"Substantial damage" means damage of 150,000 or more to pipeline and non-pipeline property.

The following definitions, as set forth in Title 49 of the Code of Federal Regulations, Parts 192 and 195, are applicable:

49 CFR 192.3

Gas

"Gas" means natural gas, flammable gas, or gas which is toxic or corrosive.

Main

"Main" means a distribution line that serves as a common source of supply for more than one service line.

Service Line

"Service line" means a distribution line that transports gas from a common source of supply to (a) a customer meter or the connection to a customer's piping, whichever is farther downstream, or (b) the connection to a customer's piping if there is no customer meter. A customer meter is the meter that measures the transfer of gas from an operator to a consumer.

Transmission Line

"Transmission line" means a pipeline, other than a gathering line, that:

- (a) Transports gas from a gathering line or storage facility to a distribution center or storage facility;
- (b) Operates at a hoop stress of 20 percent or more of SMYS: or
- (c) Transports gas within a storage field.

Transportation of Gas

"Transportation of Gas" means the gathering, transmission, or distribution of gas by pipeline or the storage of gas, in or affecting interstate or foreign commerce.

Pipeline

"Pipeline" means all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenances attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

Pipeline Facility

"Pipeline facility" means new and existing pipelines, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

49 CFR 195.2

Liquid

"Commodity" means a hazardous material that is subject to Parts 172 and 173 of this chapter, petroleum, and petroleum products.

Pipeline System

"Pipeline system" or "pipeline" means all parts of a carrier's physical facilities through which commodities move in transportation that is subject to this part, including, but not limited to line pipe, valves and other appurtenances connected to line pipe, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations and fabricated assemblies therein and carrier-controlled breakout tankage.

ALPHABETICAL LIST OF ACCIDENTS

<u>Location</u>	<u>Company</u>	<u>Date</u>	<u>Page</u>
Albemarle County, Virginia	City of Charlottesville	12/17/79	5
Bernalillo County, New Mexico	Gas Company of New Mexico	12/2/79	8
Beggs, Oklahoma	Phillip's Petroleum Company	10/30/78	11
Bon Weir, Texas	Trunkline Gas Company	10/23/80	13
Borger, Texas	Phillip's Pipe Line Company	2/2/81	16
Canton, Texas	Lone Star Gas Company	5/16/81	18
Cartwright, Louisiana	Gulf Central Pipeline Company	5/27/80	20
Cicero, Indiana	Indiana Gas Company, Inc.	9/30/80	22
Dearborn, Michigan	Michigan Consolidated Gas Company	1/11/81	24
Detroit, Michigan	Michigan Consolidated Gas Company	6/5/79	26
Dexter, Georgia	Dublin Georgia Natural Gas System	5/2/80	28
East Helena, Montana	Montana Power Company	10/1/79	30
Elizabeth, New Jersey	Elizabethtown Gas Company	7/31/80	33
Eugene Island Block 295 Gulf of Mexico	Natural Gas Pipeline Company of America	1/27/81	37
Homewood, Alabama	Alabama Gas Corporation	3/3/81	39
Keller, Texas	Lone Star Gas Company	9/28/80	41
Mexico, Missouri	Missouri Power & Light Company	1/8/81	44
Oklahoma City, Oklahoma	Oklahoma Natural Gas Company	4/24/78	46

<u>Location</u>	<u>Company</u>	<u>Date</u>	<u>Page</u>
Reading, Ohio	Cincinnati Gas & Electric Company	12/17/80	48
San Ysidro, New Mexico	Texas-New Mexico Pipeline Company	10/22/80	51
Sulphur, Louisiana	Enterprise Products Company	9/2/80	53
Tyler, Texas	Entex, Inc.	7/3/80	56

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

Pipeline Summary Report

Pipeline Accident No. : DCA-80-FP-007
Company : City of Charlottesville, Gas Division-Department
of Public Works
Location of Accident : Hydraulic Road and Solomon Road (Berkshire Apartments),
Albemarle County, Virginia.
Time : 2:38 p.m., e.s.t.
Date : December 17, 1979
Property Damage : \$1,000,000 (estimated)
Injuries : 0 Fatal
7 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of uncontrolled high pressure natural gas which had flowed through mains into an apartment complex as a result of the rupture of a regulator control line by excavating equipment.

Description of Accident

On December 17, 1979, at 2:38 p.m., e.s.t., a backhoe being used by the City of Charlottesville, Gas Division (gas company), severed a 1/2-inch steel regulator control line. The regulator opened and the downstream pressure increased rapidly from 10 inches of water column (W.C.) to 90-psig pressure. The uncontrolled high pressure natural gas flowed through mains and master meters and into 71 apartments where an undetermined source ignited the gas and started a fire. As a result of this fire, seven firemen were injured.

The City of Charlottesville was in the process of updating its gas distribution system, which serves 10,000 customers, in order to bring it into conformance with the U.S. Department of Transportation regulations, 49 CFR, Part 192.

On the morning of the accident, the gas company had connected a section of the Berkshire Apartments to a newly installed pressure regulator station, located approximately 1 1/2 blocks from the accident site. After lunch on the day of the accident, gas company employees were digging with hand tools to expose the main downstream of the regulator and connect this line to a temporary low-pressure bypass plastic line. After digging approximately 4 feet, they exposed the main. In order to make more working room, gas company employees decided to use a backhoe to enlarge the excavated hole. The backhoe bucket hit and broke the regulator's control line. The gas company's job supervisor immediately jumped into the regulator man hole and closed the downstream and upstream valves. Shortly thereafter, smoke and fire were observed coming from nearby apartments. Without delay, a valve located upstream of the regulator on Hydraulic Road and Solomon Road was also closed. Closing the valves affected approximately 431 customers.

After the accident, the gas company completed updating its system by eliminating the master meter system serving the 71 apartments. This involved replacement of the 2-, 3-, 4-, and 6-inch mains with 2-inch pipe. (Figure 1 shows preaccident conditions.) Gas was then supplied by the new regulator station, and a customer meter was set at each apartment with a service regulator and internal relief valve.

At the time of the accident, the gas company was in violation of 49 CFR 192.195(a), Protection against accidental overpressuring. This section in part states: "...each pipeline that is connected to a gas source so that the maximum allowable operating pressure could be exceeded as the result of failure, must have pressure relieving or pressure limiting devices ...". The excavation was being performed, however, to update the distribution system and to bring the old system into compliance with the existing Federal regulations including 49 CFR 192.195(a).

After the accident, the gas company completed updating its system by eliminating the master meter system serving the 71 apartments. This involved replacement of the 2-, 3-, 4-, and 6-inch mains with 2-inch pipe. (Figure 1 shows preaccident conditions.) Gas was then supplied by the new regulator station, and a customer meter was set at each apartment with a service regulator and internal relief valve.

At the time of the accident, the gas company was in violation of 49 CFR 192.195(a), Protection against accidental overpressuring. This section in part states: "...each pipeline that is connected to a gas source so that the maximum allowable operating pressure could be exceeded as the result of failure, must have pressure relieving or pressure limiting devices". The excavation was being performed, however, to update the distribution system and to bring the old system into compliance with the existing Federal regulations including 49 CFR 192.195(a).

BERKSHIRE APARTMENTS

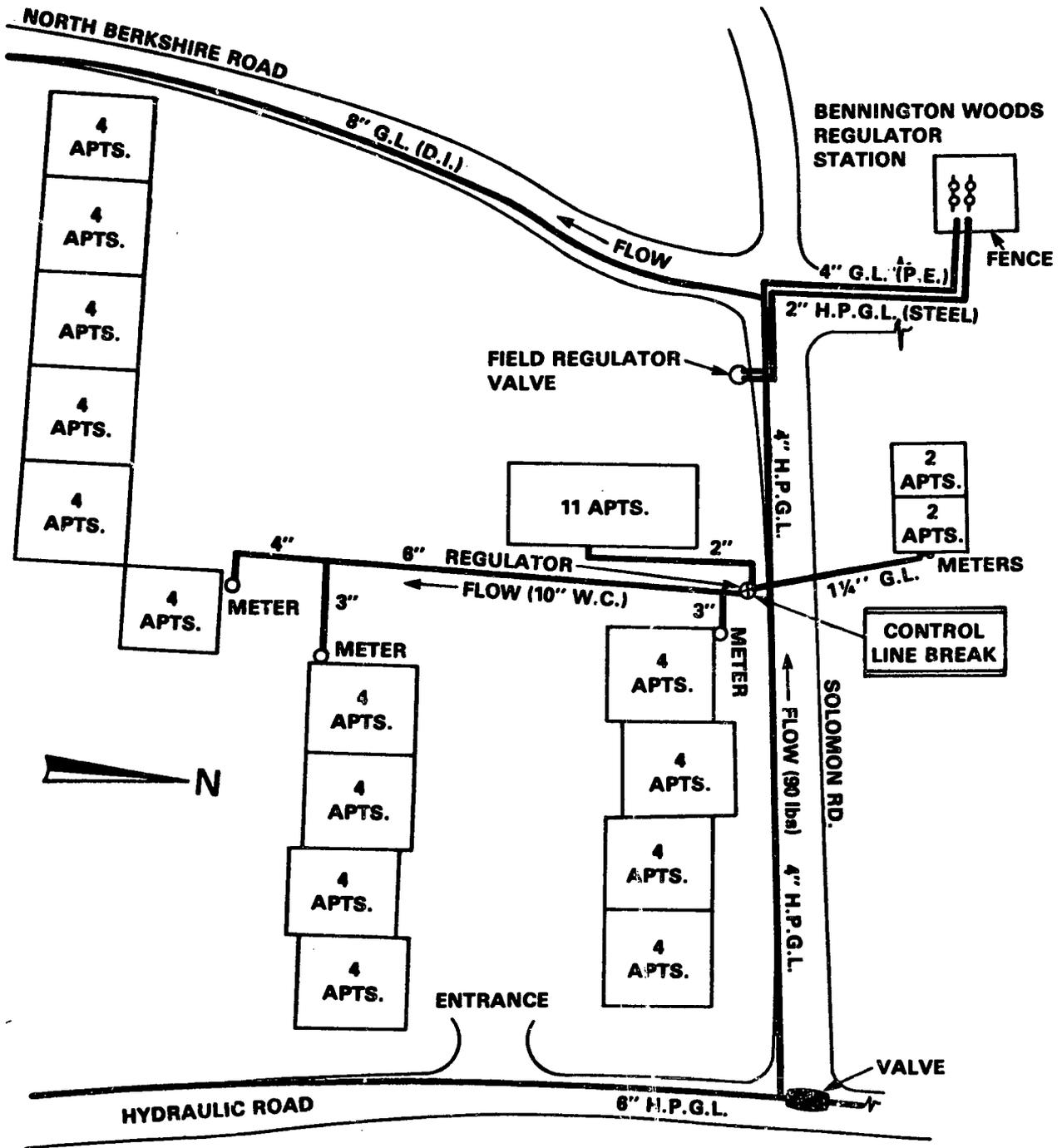


Figure 1. Plan View of Accident Site

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

Pipeline Summary Report

Pipeline Accident No. : FTW-80-FP-001
Company : Gas Company of New Mexico
Location of Accident : 807 Sunset Road, S.W., Bernalillo County,
New Mexico
Time : 8:58 a.m., m.d.t.
Date : December 2, 1979
Property Damage : \$85,000 (estimated)
Injuries : 1 Fatal
1 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of an accumulation of natural gas which had leaked from a crack in a steel gas main and migrated into a building. Contributing to the accident was the downward forces resulting from changes in ground temperature and unusually heavy vehicular traffic over the gas main which caused the already deformed steel main to crack circumferentially. Also contributing to the accident was the failure of several persons, including the fatality, to make a timely report of gas odors to the company which might have led to action to prevent the accident.

Description of Accident

At 8:58 a.m., m.d.t., on December 2, 1979, the Ohlson Clinic at 807 Sunset Road, S.W., Bernalillo County, New Mexico exploded and burned. (See figure 1.) Natural gas at 38-psig pressure had escaped from a break on a 2 3/8-inch-outside-diameter, steel coated and wrapped gas main, located 18 feet from the destroyed house. The natural gas migrated into a crawl space under the clinic and residence and spread into the living areas. Gas accumulated, formed a combustible mixture, and exploded when it was ignited by an undetermined source.

The gas company dispatch center received a call concerning the accident at 9:03 a.m., and the gas company emergency units began arriving at the site at 9:25 a.m. The crews proceeded to probe the immediate area for underground gas leaks and found readings of 80-percent gas around the corner of Sunset Road and Airway Drive. Excavation to expose the main and stop the leak did not begin until approximately 11:50 a.m. because fire officials, still looking for a missing person, would not permit the gas company to move their equipment into the area.

The gas company crew used a hydraulic squeezer to pinch the 2-inch gas main and stop the flow of gas. They cut out a short piece of the 2-inch main and capped the main to prevent leakage past the squeezer. The ground fire fed by natural gas stopped when the leak was finally contained at about 12:15 p.m.

At approximately 3:00 p.m., the fire department still had one fire hose drenching the smouldering ruins of the destroyed house. Fire department rescue personnel were still searching for the missing person. At approximately 4:10 p.m., the gas company requested permission from the fire department to install a 2-inch plastic temporary bypass because

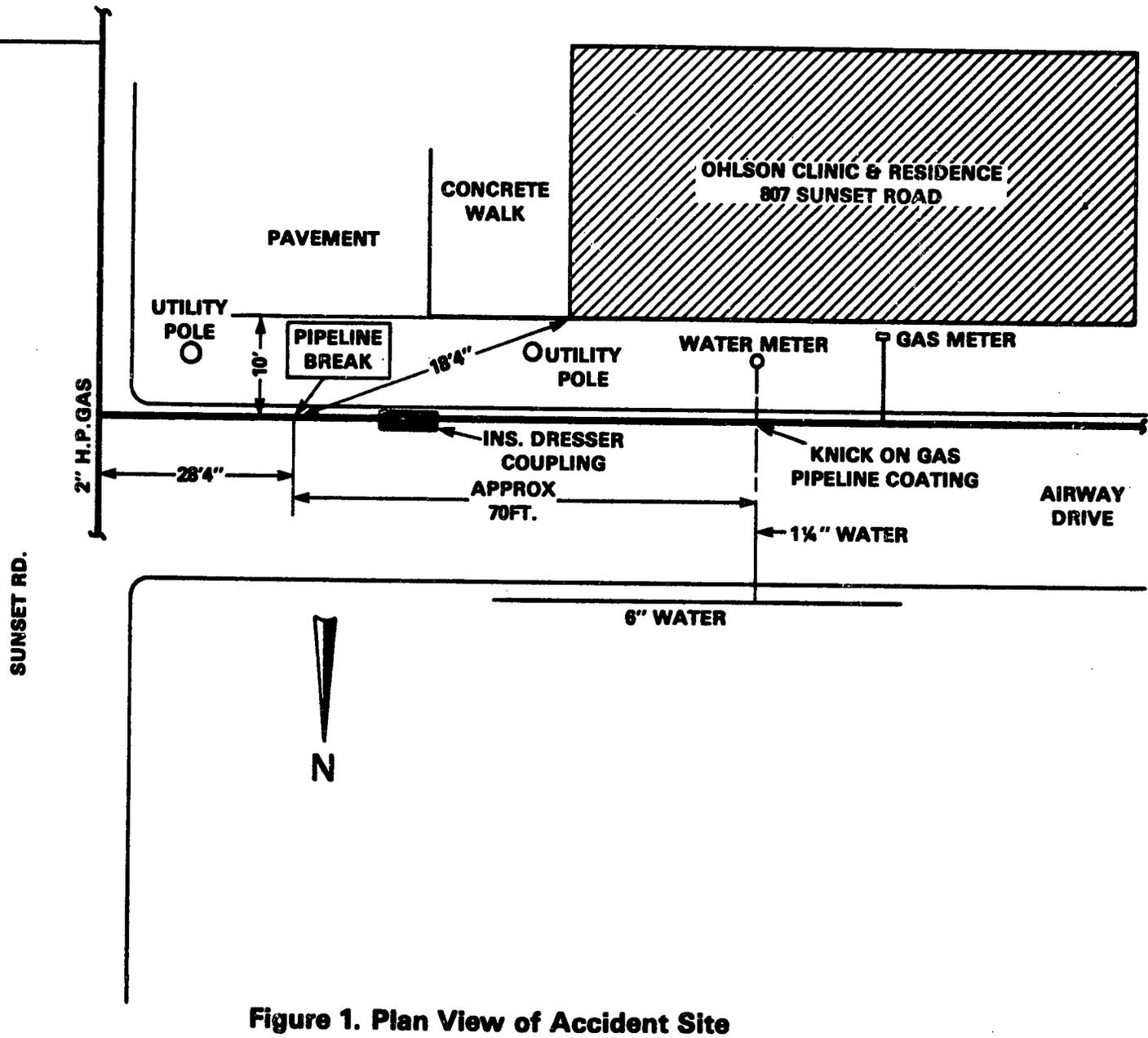


Figure 1. Plan View of Accident Site

the gas company was concerned for the welfare and comfort of 16 residents whose service had been cut off because of the leakage. Permission was granted at approximately 4:15 p.m. and service was restored at 6:00 a.m., on December 3, 1981.

Inspection of the area around the pipeline break indicated no noticeable discoloration of vegetation, but the soil was dry in an 18-inch deep and 22-inch wide cross sectional area around the break. Metallurgical examination of the damaged pipe showed that the origin point of the failure was an area of mechanical damage to the outside surface of the pipe, where it appeared to have been struck by construction equipment such as a backhoe because the bottom of the pipe showed evidence of dents and gouges in the metal surface and the pipe was bent upward. The pavement in the accident area, however, did not show any signs that any recent excavation had been done.

All known excavations and related work done in the accident area since 1974 had been done by one construction company. The construction company records and maps for the sewer system on Airway Drive showed that in 1977 an 8-inch sewer main was installed down the middle of the road at a depth of 6 feet. The width of the trench was 10 feet at road level and sloped to the center. The equipment used for the excavation would not have gotten close enough to hit the natural gas line on Airway Drive.

The Safety Board's investigation of this accident also revealed that the gas company had conducted special leak surveys on November 20 and 21, 1978, in the area of Sunset Road and Airway Drive following completion of the sanitary sewer project. The area was surveyed again on March 29, 1979, and was scheduled to be routinely surveyed again for leaks in December of 1979. The results of all the surveys were negative.

Although there was no evidence to indicate exactly when the pipe had been damaged or when the transverse crack had occurred in the pipe, the damage previously described involved a great force which caused the permanent deformation of the metal and created excessive stress concentration within a small area. The same force lifted the pipe causing it to bend and initiated tensile stresses. The downward force which precipitated the failure probably resulted from changes in ground temperature and unusually heavy street traffic. The break in the pipe was at a noticeable bend on a section of the gas main which was buried under approximately 31 inches of cover. The break in the pipe was paper thin and extended about 5 centimeters around the pipe circumference. Failure occurred on a plane perpendicular to the longitudinal axis of the pipe. Because the dent area was bare, clean metal and showed no evidence of corrosion and because the metallic grain in the break was clean and crystalline, the break probably occurred recently.

The residential part of the clinic was occupied by a doctor and his wife, who was fatally burned. She had complained to her husband about gas odors on the evening and morning before the accident. Her husband, however, did not smell the gas because his sense of smell had been reduced due to a nasal operation. The nurses and staff of the Ohlson Clinic indicated that they did not smell natural gas during work on Saturday morning, the day before the accident. A woman who had driven by the house on the morning before the accident said later that she had smelled gas, and neighbors said that they also had smelled gas. No one, however, had notified the gas company or the fire department of the odor. Some residents stated that they did not know who or where to call to report the odor of natural gas. The gas company has a continuing program for public awareness of how to recognize and report natural gas odors. If someone had notified the gas company when the odor was first detected, this accident could have been prevented.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: FTW 79-FP-002
Company: Phillips Petroleum Company
Location of Accident: Beggs, Oklahoma
Time: 8:20 p.m., c.d.t.
Date: October 30, 1978
Property Damage:
Injuries: 2 fatal
1 nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition, by sparks from the engine of a passing pickup truck, of gas escaping from a 6-inch natural gas gathering line which failed at a pressure of 900 psig at a stress position induced by a torch-cut flaw intentionally introduced during construction of the line 26 months before.

Description of the Accident

At 8:20 p.m., c.d.t., on October 30, 1978, about 3 1/2 miles southeast of Beggs, Oklahoma, a 6-inch natural gas gathering line operating at 900 psig ruptured. At 8:30 p.m., escaping natural gas was ignited by a pickup truck which was passing through a depression along a dirt road 400 feet from the leak. Of the three occupants of the truck, two were killed, and the third was injured.

The Phillips Petroleum Company (Phillips) field operations foreman heard the explosion from his home near Beggs, and saw the resulting fire. The foreman radioed the Creek Gas Plant at Gienpool to notify them of the problem and called two field coordinators to request that the Wadsworth and Taylor Boosters be checked. The rupture had occurred in the 6-inch line between the two boosters. He then drove 6 miles to the location where the 6-inch line fed into an 8-inch main line, closed the 6-inch line gate valve, and opened the vent valve.

At 8:35 p.m., monitoring equipment at the Creek Gas Plant showed that the Wadsworth Booster was shut down. While the shutdown was coincident with the rupture, the Wadsworth Booster was downstream of the rupture and had responded to a high-pressure shutdown device set at 950 psig which was activated when a large downstream customer stopped accepting delivery of gas. The Taylor Booster which was upstream of the rupture was shut down manually at 9:00 p.m., thus isolating the break.

The 6 5/8-inch O.D. X 0.156 W.T. API5L pipeline was installed by Cimarron Pipeline Construction, Inc. and hydrostatically tested at a pressure of 1,580 psig for 24 hours in June 1976. The test was the basis for a maximum allowable operating pressure (MAOP) rating of 1,436 psig. The pipeline was placed in service on August 10, 1976, as part of Phillips Creek Gas Gathering System.

After the accident, the failed pipeline was excavated and examined. The metallurgical report stated, "The failure apparently initiated along an 8-inch long flaw, or gouge, located on the external surface" on the bottom of the pipe. "The failure propagated in both directions from this flaw in a helical fashion around the pipe for approximately two revolutions. . . About 2 1/2 feet of pipe length was involved in the failure, and the curved fracture surface was about 88 inches long."

The metallurgical report further stated that the flaw had been "Intentionally introduced in the field during or immediately after assembly of the pipeline, apparently by means of an oxyacetylene torch or similar device. This determination was made by experiments involving the possible alternatives: (1) melting or cutting by gas or electric welding equipment, (2) mechanical gouging or grinding, and (3) localized corrosive attack. Location of the flaw 2 1/2 feet from the nearest girth weld eliminated accidental creation. The flaw was sufficiently shallow that the pipeline passed the field hydrostatic test, but subsequently grew to a critical size as a result of cyclic pressures occurring during the operation of the pipeline."

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.:	FTW 81-FP-003
Company:	Trunkline Gas Company
Location of Accident:	Quicksand Creek Gas Field, BonWier, Texas
Time:	11:35 a.m., c.d.t.
Date:	October 23, 1980
Property Damage:	
Injuries:	<hr/> 1 fatal 1 nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the hydraulic overpressuring of a valve due to an improper lubrication procedure.

Description of the Accident

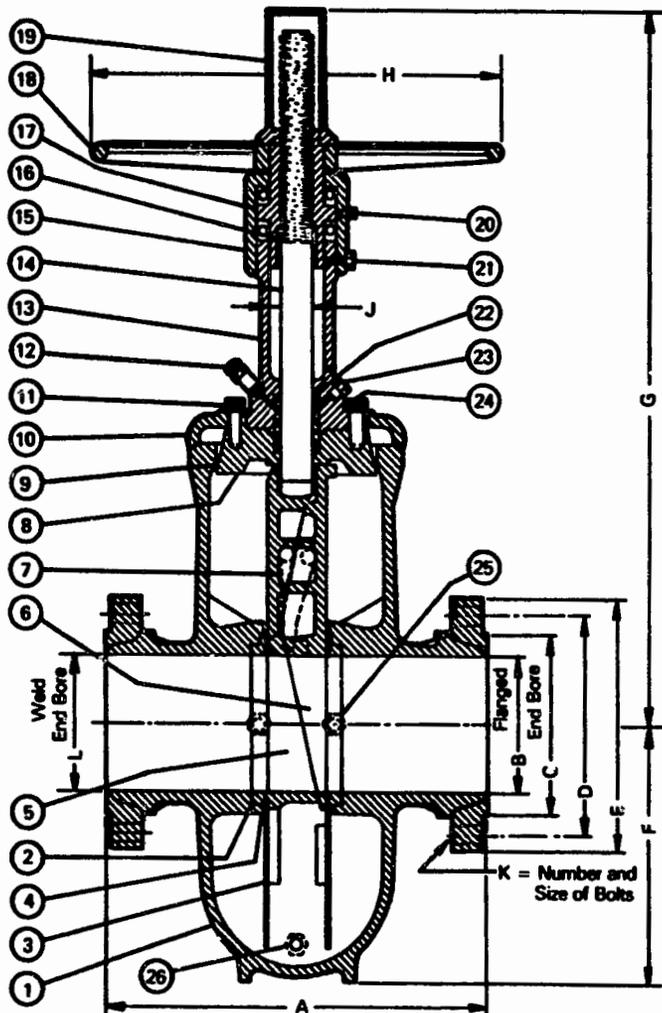
At 11:35 a.m., on October 23, 1980, a gate valve on a gathering line in the Quicksand Creek Gas Field near Bon Weir, Texas ruptured during a valve inspection, injuring the two-man crew, one fatally. The Safety Board investigation disclosed the following circumstances leading up to the accident.

The accident involved a 6-inch, ASA 600, W-K-M, WExFE, rising stem handwheel-operated gate valve (See figure 1) installed on a gathering line at the Quicksand Creek Gas Field near Bon Weir, Texas. Located 30 inches below ground level in a 4-foot-deep, 4 1/2-foot-diameter corrugated metal canopy, ^{1/} the valve was just downstream of the Trunkline Gas Company's Duer Wagner-Quicksand Measuring Station.

At 11:30 a.m. on October 23, two crewmembers arrived at the Duer Wagner Measuring Station to perform a semiannual valve inspection, which primarily involved checking and lubricating the valve stem and seats and performing a 50 percent operation of on-stream valves. After removing the valve canopy cover, one of the crew climbed into the canopy, removed the caps from the two fittings on the valve seat lubricator, pumped five to six shots into each fitting with a grease gun rated at 15,000 psi, and replaced the caps.

While the crewmember in the canopy was pumping grease, his partner removed the stem packing cap, inserted grease into the fitting, and replaced the cap. When they finished lubricating various other valve components, including the upper body grease fitting but not the lower body grease fitting which was coated with the dirt, the crewmember in the canopy tried to operate the valve but could not move the handwheel. Attempting to exert more force, he leaned back while his partner knelt over the canopy to help him turn the wheel. The crewmember in the canopy felt the valve turn, heard a pop and felt the handwheel leave his hand; he was blown out of the canopy by the force of the explosion. Valve parts blew out of the valve body and canopy and scattered about the area, fatally striking the workman kneeling over the canopy.

^{1/} A circular shelter or pit.



Parts List			
Symbol	Name	Material	No. Req'd
1	Body	Cast Steel	1
2	Seat	Steel	2
3	Seat Skirt	Steel	2
4	Seat Insert	Teflon	2
5	Gate	Cast Steel	1
6	Segment	Cast Steel	1
7	Lever Lock Arm Assy	Steel	2
8	Bonnet	Cast Steel	1
9	Seal Ring	Steel	1
10	Clamp Ring	Cast Steel	1
11	Clamp Ring Cap Screw	Steel	Varies
12	Packing Fitting	Steel	1
13	Yoke Tube	Cast Steel	1
14	Stem	Steel	1
15	Yoke Nut	Cast Steel	1
16	Thrust Bearing	Steel	2
17	Stem Nut	MN Bronze	1
18	Handwheel	Malleable Iron	1
19	Stem Protector	Steel	1
20	Yoke Grease Fitting	Steel	1
21	Lock Screw	Steel	1
22	Packing Adapter Ring	Asbestos Buna-N	2
23	Packing Plug	Steel	1
24	Packing	Plastic	
25	Seat Lubricator	Steel	2
26	Body Grease Plug	Steel	2

M = Number of Turns to Open

Size	A	B	C	D	E	F	G	H	J	K	L	M
6	22	6 1/16	8 1/2	11 1/2	14	12 5/8	35 7/8	18	1 1/2	12-1		25
8	26	8 1/16	10 5/8	13 3/4	16 1/2	15 7/16	46 1/8	26	2	12-1 1/8		27 1/4
10	31	10	12 3/4	17	20	19 3/4	55 1/4	32	2 1/4	16-1 1/4		33 3/4
12	33	12	15	19 1/4	22	23	64	32	2 1/4	20-1 1/4		38 3/4

AS SPECIFIED
BY PURCHASER

Figure 1.

W-K-M DIVISION ACF INDUSTRIES INCORPORATED	
ASA 600 POW-R-SEAL PIPE LINE GATE VALVE	
Drawn by: STRICKLAND	B 11-19-62
Date: 11-15-62	LR 26956-B

Hydraulic pressure during lubrication overpressured the valve cavity and led to the explosive failure. The grease gun, rated at 15,000 psig, had more than sufficient capacity to rupture the valve. The crewmembers, for reasons unknown, lubricated the upper body grease fitting without using the safety pressure relieving tool, as specified in the W-K-M manual for "Installation, Operation & Maintenance of W-K-M Through-Conduit ANSI Gate Valves." The pressure relieving tool was found in the truck; dirt covered the lower body grease fitting of the valve where the tool would have been applied if proper procedure had been followed.

The W-K-M manual also contains a troubleshooting chart of problems that may be encountered when working with W-K-M valves. The trouble the men encountered with the Quicksand Creek valve, "will not open or close," has cited as a probable reason "pressure locked," which is defined as a "condition which exists in any double sealing expanding gate valve when the body pressure exceeds the line pressure by an excessive amount..." and as a remedy, "drain body pressure..." The attempt to turn the handwheel without first relieving the body pressure provided the additional force needed to precipitate the explosive failure.

The fatally injured workman had more than 15 years of maintenance experience and should have been familiar with the appropriate lubricating procedure. In contrast, his partner had less than 6 months of service with the Trunkline Gas Company.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

PIPELINE SUMMARY REPORT

Pipeline Accident No.: FTW 81-FP-007
Company: Phillips Pipe Line Company
Location of Accident: Borger, Texas
Time: 4:10 p.m., c.s.t.
Date: February 2, 1981
Property Damage: \$300,000
Injuries: 1 fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of vaporized liquid butane which had leaked into a pump room because of improper valve alignments and a blocked drain..

Description of the Accident

On February 2, 1981, about 4:10 p.m., an accumulation of butane vapors in a pump room at the Phillips Pipe Line Company's Borger Products Station in Borger, Texas ignited. The resulting explosion killed one employee working in the pump room and destroyed all controls and instruments for two pumping stations within the Borger complex, as well as control rooms, meter runs, pumps and a header. The Safety Board investigation disclosed the following circumstances leading up to the accident.

Pumping equipment at the Borger Products Station moves various products from the Borger Refinery to Chicago, Illinois; Denver, Colorado; and Amarillo, Texas. That portion of the Borger complex that pumps to Chicago is called the Borger-Chicago Station; to Denver and Amarillo, the Rocky Station.

About noon, on February 2, 1981, the Borger-Chicago Station was shut down to make tie-ins on certain pipelines. Before work could begin, product had to be drained from part of the system. The drain system, which is used to check for leaking valves in the header as well as to drain the pumps, is open to the atmosphere in the header area and drains to a receiving tank. To drain the system some valves had to be opened and some closed to isolate the pipe to be tied in.

By 3:45 p.m., the connections were completed, closed valves opened, opened valves closed and pumping resumed on the two lines shut down at noon. After pumping was restarted, an engineer returned to the pump room in the Borger-Chicago Station. Seeing liquid butane flowing under the door of the sample room and backing up through the drain in the sample vat, he closed the drain valve to stem the flow of butane. Subsequently, the engineer, terminal superintendent and dehydrator operator conducted cursory visual inspections of pipes in the pump room and header and dehydrator areas to ensure valves were correctly aligned. They found nothing amiss.

At 4:05 p.m., however, when the dehydrator operator checked the receiving tank, though it was full, liquid was not flowing from the open drain above, indicating the drain was plugged.

At 4:10 p.m., as the engineer and dehydrator operator walked toward the Rocky Station control room, they saw the Rocky Station pump and control rooms explode. Liquid butane, which had leaked under the header and meter run, had vaporized and been ignited by some undetermined source.

The drain valve on pump 4A in the Borger-Chicago Station, which earlier was opened for tie-in work and should have been closed before pumping resumed, inadvertently was left open. This permitted liquid butane to flow into the open drain system. A blockage in the drain system then caused butane to overflow from the open drains. The cursory line-of-sight valve examination was inadequate to assure valves were in the proper positions.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: FTW 81-FP-009
Company: Lone Star Gas Company
Location of Accident: Canton, Texas
Time: 4:00 a.m., c.d.t.
Date: May 16, 1981
Property Damage: \$100,000
Injuries: 11 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition, by an undetermined source, of gas which had migrated into the house through a sewer tile after leaking from a circumferential break in a gas service line at its threaded connection with an elbow. The natural gas escaping at 10 psig was impeded from venting to the atmosphere by the blacktopped driveway above the leak.

Description of Accident

At 4:00 a.m., c.d.t., on May 16, 1981, in Canton, Texas, natural gas at a pressure of 10 psig leaked from a circumferential fracture in the threads at an elbow on a 1 1/4-inch bare steel yard line. The gas migrated into a house 25 feet away where it was ignited by an undetermined source. The resulting explosion and fire destroyed the brick house and 1 vehicle, and injured the 11 occupants. Nine of the occupants were hospitalized, several in serious condition; the other two were released after treatment.

After debris was removed from the meter set, which was adjacent to the side of the house near the front corner, the gas was shut off. A test on the service line failed to hold pressure. Because torrential rainfall during and after the accident made bar hole tests and other excavation impractical, further investigation was postponed until May 18, 1981. At that time, bar hole tests made through a blacktopped driveway which covered most of the service line revealed the presence of natural gas. Gas was also found around the slab of the house, predominantly across the front and on the side where the meter was located. Sixty hours after the explosion, a combustible gas indicator revealed a 7-percent reading in the open sewer drainpipe at slab level.

The odorant level was adequate, as determined by smell and odorometer tests after the accident. However, one of the occupants stated that he had not detected any odor before the explosion and none of the other occupants had mentioned any unusual odors. One person who had been digging alongside the house about 20 feet from the service riser several months before the accident described the soil there as having a "pig-pen" odor. Cover over the yard line ranged from 6 to 18 inches.

The leak was found by pressurizing the line. A circumferential fracture extended from about the one o'clock to the five o'clock position (looking upstream) at the entry of threads into a 120-degree elbow, where stress was concentrated in the thread immediately short of make-up in the elbow. The elbow was located 25 feet from the service riser and 6 feet from an abandoned sewer tile crossing. Two other leaks were found at collars but were not significant. Gas readings were obtained in the side yard septic field served by this sewer line as well as in the new septic field to the rear-side of the house and the sewer drainpipe.

The threaded and coupled, 1 1/4-inch bare steel yard line was insulated at its connection with the company's service line, which tapped the end of a 2-inch coated and wrapped main with a maximum allowable operating pressure (MAOP) of 35 psig and operating at a pressure of 10 psig. The yard line ran diagonally 175 feet to the leaking elbow then 25 feet to the riser at the corner of the house. It reportedly had been installed by a private contractor, then inspected and pressure tested by Lone Star before being placed in service.

The leak appeared to have developed a considerable period of time before the accident. Sufficient connection existed between the abandoned and the active sewer systems to account for the migration of natural gas into both systems, including the sewer drainpipe within the house. This was the probable path of migration from the leak to the point of ignition.

The leak may have been present during the survey conducted some 11 months before the accident, but was not sufficient to be detected because the ground over the service line was covered by a blacktopped driveway which prevented the natural upward movement of gas.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: FTW 81-FP-010
Company: Gulf Central Pipeline Company
Location of Accident: Cartwright, Louisiana
Time: 12:15 p.m., c.d.t.
Date: May 27, 1981
Property Damage: \$50,000 to \$100,000
Injuries: 14 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the puncture of a 10-inch steel anhydrous ammonia pipeline by the blade of a bulldozer working at a well drilling location.

Description of Accident

At 12:15 p.m., c.d.t., on May 27, 1981, near Cartwright, Louisiana, a bulldozer working at a well drilling location punctured a Gulf Central Pipeline Company 10-inch steel anhydrous ammonia pipeline. Anhydrous ammonia under a pressure of 550 psig sprayed into the air. At least 14 people required medical treatment as a result of the accident, and approximately 100 persons were evacuated within a 2-mile radius of the accident site.

The construction company bulldozer was clearing a well site and excavating a trash pit for Mitchell Energy and Paramont Drilling Company. The pit was located over the pipeline at a location 275 feet south of where the pipeline intersected a road. Pipeline markers were located on both sides of the road. Gulf Central was not notified of the excavation work, and the bulldozing operation had not commenced at the time that the last pipeline aerial patrol was flown. The State of Louisiana has a voluntary one-call system to assist excavators in obtaining the locations of underground facilities.

The Louisiana State Police received notification of the accident at 12:21 p.m. and dispatched its two nearest units. The Louisiana State Police then notified Gulf Central's pipeline dispatcher in Tulsa, Oklahoma, of the accident at 12:25 p.m., 10 minutes after the puncture occurred. The Louisiana State Police also notified the National Response Center. After assessing the hazards involved, the Louisiana State Police and the Jackson Parish Sheriff's Office began an evacuation of the area within a 2-mile radius of the accident site. This evacuation was completed by 1:00 p.m.

Fourteen State Police units were eventually in service, assisted by units from the Jackson Parish Sheriff's Office, Lincoln Parish Sheriff's Office, and the Quachita Parish Sheriff's Office. Movement of the ammonia cloud was monitored from the ground and air by the State Police, the Louisiana Forestry Commission, and Gulf Central.

Some 27 hours after the accident, following a survey of the general area, some of the people evacuated were permitted to return and the evacuation area was reduced to a 1-mile radius of the accident site.

When the Louisiana State Police notified Gulf Central of the accident, Gulf Central stopped pumping immediately and dispatched two of its operations personnel; a five-man repair crew was dispatched an hour later. The break was isolated by closing automatic and manual block valves within 4 hours of the accident.

The 10 3/4-inch O.D x 0.250-inch W.T., X-42 pipe was operating at a pressure of 550 psig when it was punctured. Its maximum allowable operating pressure was 1,406 psig. Maximum pump capacity was 271 tons of anhydrous ammonia per hour, but the actual rate was 35 tons per hour. Loss of anhydrous ammonia totaled 613 tons from the 10-mile segment of pipeline that was isolated.

After pumping was stopped, the further loss of the liquid anhydrous ammonia from the isolated segment of the pipeline through the 1-inch by 4-inch puncture was slow. About 2 feet of liquid ammonia settled in a pool over the break. Efforts to dig a ditch to drain the liquid away from the break were unsuccessful because the ground was frozen for a distance of up to 30 feet due to the rapid evaporation of the ammonia. After the liquid had drained away and line pressure had subsided to 55-60 psig, 48 hours after the accident, a repair crew attempted to place a sleeve valve on the ruptured pipeline. They were not successful because the pressure was still too high.

The Louisiana State Police flew over the area in a helicopter 48 hours after the pipeline was punctured. They observed damage to trees and vegetation for up to 1 1/2 miles from the site. There were no reported deaths to livestock or domestic animals; however, a large fish kill occurred in a private pond one-half mile from the accident site. Gulf Central surveys indicated that an area 2 miles in diameter around the leak was affected by ammonia vapor migration. Gulf Central helped limit the area of vapor migration by using propane in two pits to burn the ammonia.

Seventy-two hours after the accident occurred, temporary repairs were completed and the line was placed back in operation. At this time, the remaining 50 people that had been evacuated were allowed to return to their homes. Permanent repairs were made 11 days later by replacing a 10-foot section of the pipe.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

PIPELINE SUMMARY REPORT

Pipeline Accident No.: FTW 80-FP-008
Company: Indiana Gas Company, Inc.
Location of Accident: State Highway 19, one mile north of
Cicero, Indiana
Time: 11:35 a.m., c.d.t.
Date: September 30, 1980
Property Damage: \$500,000
Injuries: 2 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by a pilot light of an accumulation of natural gas in a church basement. The gas had leaked from a broken threaded fitting on a 3/4-inch service line which had been caught and pulled by a trenching machine being operated outside the church. Contributing to the accident was the contractor's failure to notify the gas company about the proposed excavation to allow the gas service line to be located and worked before excavation was begun.

Description of the Accident

In 1960, a 135-foot, 3/4-inch coated and wrapped steel gas service line was installed by a pipeline contractor for the Seventh Day Adventist Church. The service line entered the north side of the church basement below grade, through a sleeve in the cement block foundation at a depth of 24 inches. The meter set assembly, which was installed below the service line in the church basement, terminated in a lockwing shut-off valve, and then elbowed down to a pressure regulator and meter. A vent line for the regulator was installed through a sleeve in the wall adjacent to the service entry.

In September, 1980, a private contractor was hired to trench around the exterior of the church to provide drainage and alleviate moisture problems in the basement. The contractor walked around the church twice looking for a gas meter before beginning to trench but he did not enter the church basement in his search. Neither he nor the church contacted the gas company to request that they stake the location of the gas service. No "one-call" system or requirement for excavators to consult with or notify the operators of underground facilities was in effect in the State of Indiana.

On the morning of September 30, 1980, the contractor was operating his small "Ditch Witch" trencher moving eastward at a distance of 7 1/2-feet from the north wall of the church. While trenching at a depth of 28 inches, the trencher momentarily snagged the 3/4-inch gas service line. The contractor was not aware that he had struck the service line and continued trenching eastward. The service line, which was bent 10 1/2 inches out of alignment, was pulled sufficiently to break a threaded elbow at the lockwing shutoff valve within the church basement. Gas escaped into the basement at a pressure of 35 psig.

The gas-air mixture was ignited at 11:35 a.m. when it reached the pilot light either on the furnace or the water heater. The resulting explosion and fire destroyed the church. The trenching machine operator was injured, treated at the hospital, and then released. The pastor and secretary of the church were working in the basement office 50 feet from the broken elbow but were not hurt. One fireman was later treated for smoke inhalation. There were no other injuries.

The Cicero Fire Department responded promptly and arrived within 5 minutes, and the Jackson Township Fire Department was at the scene within 10 minutes. Six other fire departments also assisted.

The Indiana Gas Company was notified by telephone 8 minutes after the explosion, and gas company personnel first reached the site 7 minutes later. Nine employees in all were dispatched to participate in the emergency operations and included pipe fitters, welders, servicemen, foreman and supervisors. Since there was no readily accessible shutoff valve on the service line, information as to the location of the service line was requested by radio from the gas company's office; however, the gas company's service department was unable to promptly locate a record with that information. Therefore, at 12:35 p.m., the gas company squeezed off a section of 2-inch polyethylene main about 200 feet upstream from the service tap. As a result, gas flow to the church was shut off and service to two other customers was interrupted. Service was restored about 24 hours later.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: DCA-81-FP-007
Company: Michigan Consolidated Gas Company
Location of Accident: Dearborn, Michigan
Time: 12:05 p.m., e.s.t.
Date: January 11, 1981
Property Damage: \$800
Injuries: 1 Fatal
1 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was a break in a regulator control line located in an underground vault from undetermined causes. Contributing to the severity of the accident was the failure of the two repairmen who entered the underground vault to control the leak and to utilize proper safety equipment.

Description of Accident

At 9:40 a.m., January 11, 1981, the Michigan Consolidated Gas Company (gas company) Customer Service received a leak report from a motorist who detected an odor of gas while driving by Southfield Road and Michigan Avenue, Dearborn, Michigan.

At 9:43 a.m., the gas company dispatched an employee to determine the source of leaking natural gas. At 10:03 a.m., the employee reported that there was natural gas blowing out from one of the gas company's manholes. At the same time, he requested that personnel from the company's distribution department be dispatched; the distribution department requested that a pressure crew also be dispatched to the scene.

At 12:05 p.m., on Sunday afternoon, the pressure crew consisting of a foreman and a workman arrived on the scene after having been summoned from their homes. They immediately proceeded to remove the cover from the manhole. The crew foreman descended into the vault, followed by the workman. Both employees were overcome by the high concentration of natural gas. Air breathing equipment was available but was not used by either employee.

At 12:12 p.m., one of the distribution department employees reported to the gas company that the two pressure crewmen had passed out in the vault and requested assistance from the fire department. At 12:27 p.m., the fire department rescue squad arrived and was able to revive the workman but was unable to revive the supervisor.

At 12:38 p.m., the two gas company employees were taken to a hospital by the rescue squad. The foreman was pronounced dead at 1:35 p.m., on January 11, 1981.

The reinforced concrete vault at the accident site was built in 1956 and contained two regulators in series which reduced the pressure from approximately 250 psig to 85 psig in two steps. Investigation revealed that the upstream control line was broken off at the shoulder of the 45-degree flare nut which connected the control line to the regulator. The cause of the break was not determined. When the rupture occurred, the inlet pressure of approximately 250 psig blew from the full open end of the broken line. The seven-day pressure chart for the Michigan/Southfield area read after the accident indicates that the control line broke about 11:00 p.m., January 10, 1981.

The gas company conducted an annual inspection of the vault on September 9 and 10, 1980; the condition of the control lines was recorded as satisfactory at that time.

The pressure crew foreman entered the underground vault when it was unsafe to do so, even though the gas company's established procedures required that vaults be tested for natural gas and oxygen prior to entry. In this accident, the opened manhole, the odor, and the loud noise of the blowing natural gas under high pressure should have been sufficient to alert an experienced gas company employee that it was not safe to enter the underground vault without air breathing equipment.

The pressure crew foreman had 20 years of experience in gas regulator installation and maintenance; the workman had 2 years of experience. Gas company records indicated that both employees had attended safety meetings within 30 days of the accident. Those meetings included the use of air breathing equipment.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

Pipeline Summary Report

Pipeline Accident No.	:	DCA-79-FP-016
Company	:	Michigan Consolidated Gas Company
Location of Accident	:	14039 Ardmore Avenue, Detroit, Michigan
Time	:	2:15 a.m., e.s.t.
Date	:	June 5, 1979
Property Damage	:	\$50,000 (estimated)
Injuries	:	1 Fatal 2 Nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of an accumulation of natural gas which had leaked from an unauthorized connection of an indoor garden hose to a gas meter valve.

Description of Accident

On June 5, 1979, at approximately 2:15 a.m., e.s.t., a natural gas explosion and fire destroyed a house and extensively damaged four adjacent houses in Detroit, Michigan. (See figure 1.) A garden hose which had been connected to a gas meter valve failed and allowed natural gas to escape until an explosive mixture of gas in air was reached. As a result of the accident, one infant was fatally burned and two other persons injured.

The house which was destroyed had two meters located in the basement, one for the first floor and the other for the second floor. On March 20, 1978, the Michigan Consolidated Gas Company (gas company) disconnected the gas meter for the second floor from active use because of nonpayment of charges. The shutoff valve in the meter bar was closed with a locking device in order to prevent the valve from being opened by unauthorized persons. Eight months later, on November 8, 1978, the gas company discovered that the lock had been removed and unauthorized use of natural gas had occurred. The gas company, therefore, removed the gas meter and again locked the meter bar valve in the off position.

Investigation on June 5, 1979, of the explosion and fire revealed that the shutoff valve in the meter bar had been turned on by breaking the locking device. Since the shutoff valve on the first floor gas meter was also in the open position, it appears that the piece of garden hose had been connected to the upstream side of the first floor gas meter to illegally obtain natural gas for consumption. The garden hose failed and natural gas leaked into the building. Ignition of the accumulated gas by an undetermined source resulted in the explosion and fire.

Although the occupants of the house stated that unauthorized use of the natural gas had started only after the meter was removed on November 8, 1978, it is most likely that use had been occurring since the gas company disconnected the meter in March because the occupants also stated that they had never been without heat, hot water, or cooking gas.

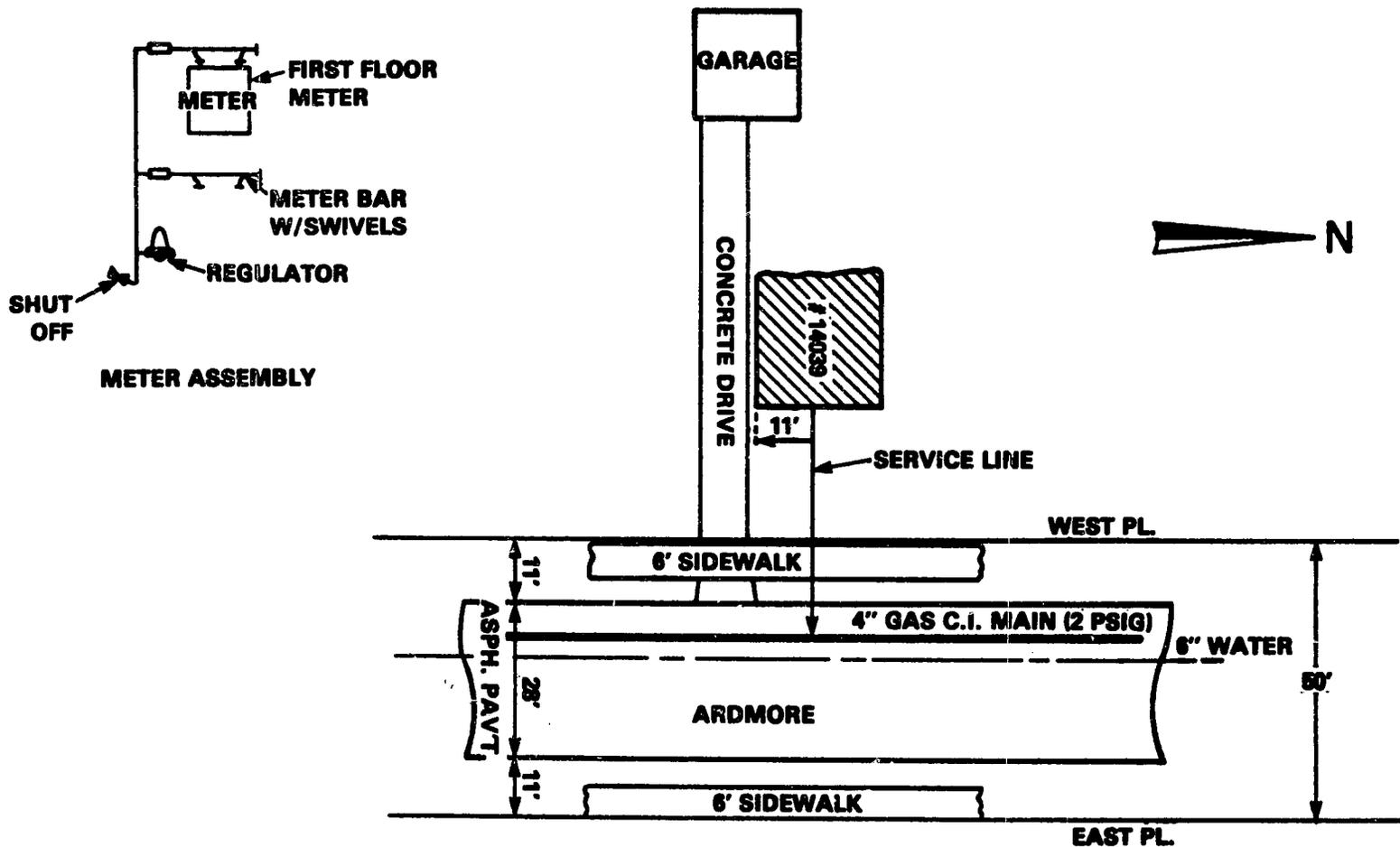


Figure 1. Plan View of Accident Site

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: ATL-80-FP-001
Company: Dublin, Georgia Natural Gas System
Location of Accident: Dexter, Georgia
Time: 8:01 p.m., e.d.t.
Date: May 2, 1980
Property Damage: Minimal
Injuries: 3 fatal
4 nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by a propane torch of natural gas which was released under 300 psig when a poorly restrained length of 8-inch pipe pulled out of a compression coupling.

Description of the Accident

On May 2, 1980, about 8:01 p.m., a natural gas explosion and fire at a construction site near Dexter, Georgia killed three and injured four workmen. The Safety Board investigation disclosed the following circumstances leading up to the accident.

On the day of the accident a pipeline construction company hired by the city of Dublin, Georgia, was engaged in replacing and relocating a section of 8-inch gas pipeline installed in 1968 alongside a bridge over Rocky Creek.

Upstream of the bridge crossing, the 8-inch pipeline entered an underground brick vault which contained an 8-inch gate valve and a style 38-type Dresser coupling ^{1/} downstream of the valve. This in-line coupling, as originally installed, was secured against pullout forces.

The relocation was effected, without consideration of the coupling, by the construction of an 8-inch bypass parallel to the bridge-crossing section to be abandoned. The bypass was tied into the existing pipeline on either side of the bridge, with the upstream tie-in located 12 feet downstream of the coupling. Here a 90-degree elbow was welded downward from the existing line to a 2-foot pipe section and then to another 90 degree elbow which was welded to the bypass at a 45-degree angle from the existing pipeline. This diagonal section of the bypass was partially backfilled only about 14 feet from the tie-in.

At the time of the accident, the task of relocating the pipeline was almost complete. Three of the contract workmen were in an 8-foot trench at the upstream connection of the newly installed pipe. They were using a propane torch to soften the tar adhesive on wrapping tape. Three other workmen were similarly engaged in a trench on the downstream side of the bridge where the new pipeline joined the existing line. Once the pipe was wrapped, it would remain only to backfill the trenches.

1/ Dresser Coupling - A gasketed fitting used to join pipe ends by compression.

About 7:30 p.m., the assistant superintendent from the Dublin, Georgia Natural Gas System opened the gate valve in the underground brick vault to allow gas to flow into the newly installed line. The new pipeline operated close to its normal pressure of 300 psig for about 30 minutes. However, at 8:01 p.m., the underground vault exploded and flames erupted. The nearby trench was engulfed in flames, fatally injuring the three workmen taping pipe there and injuring two who were standing at the lip of the trench. Two of the three men in the trench across the creek also were burned when earthen plugs blew out of the abandoned pipeline.

The gas company's assistant superintendent radioed workmen manning the upstream and downstream control valves to close both valves. Gas flow was stopped 4 1/2 minutes after the accident, and property damage was minimal.

Postaccident investigation revealed that the pipeline was disengaged from the Dresser coupling, and that the downstream end moved 21 inches out of alignment because it was inadequately restrained. Further investigation revealed that the construction specifications called for a 45 degree elbow rather than the 90-degree elbows that were used; correct elbows would have provided an additional degree of restraint. It also appeared that the engineering drawing was in error; it showed the Dresser coupling upstream of the gate valve. Further cold wrap, had been specified rather than the hot wrap which was used and thereby required use of a propane torch which served as the source of ignition of the natural gas. Finally, the abandoned section of pipeline was plugged with earth rather than capped as specified; use of the latter measure, would have prevented two injuries.

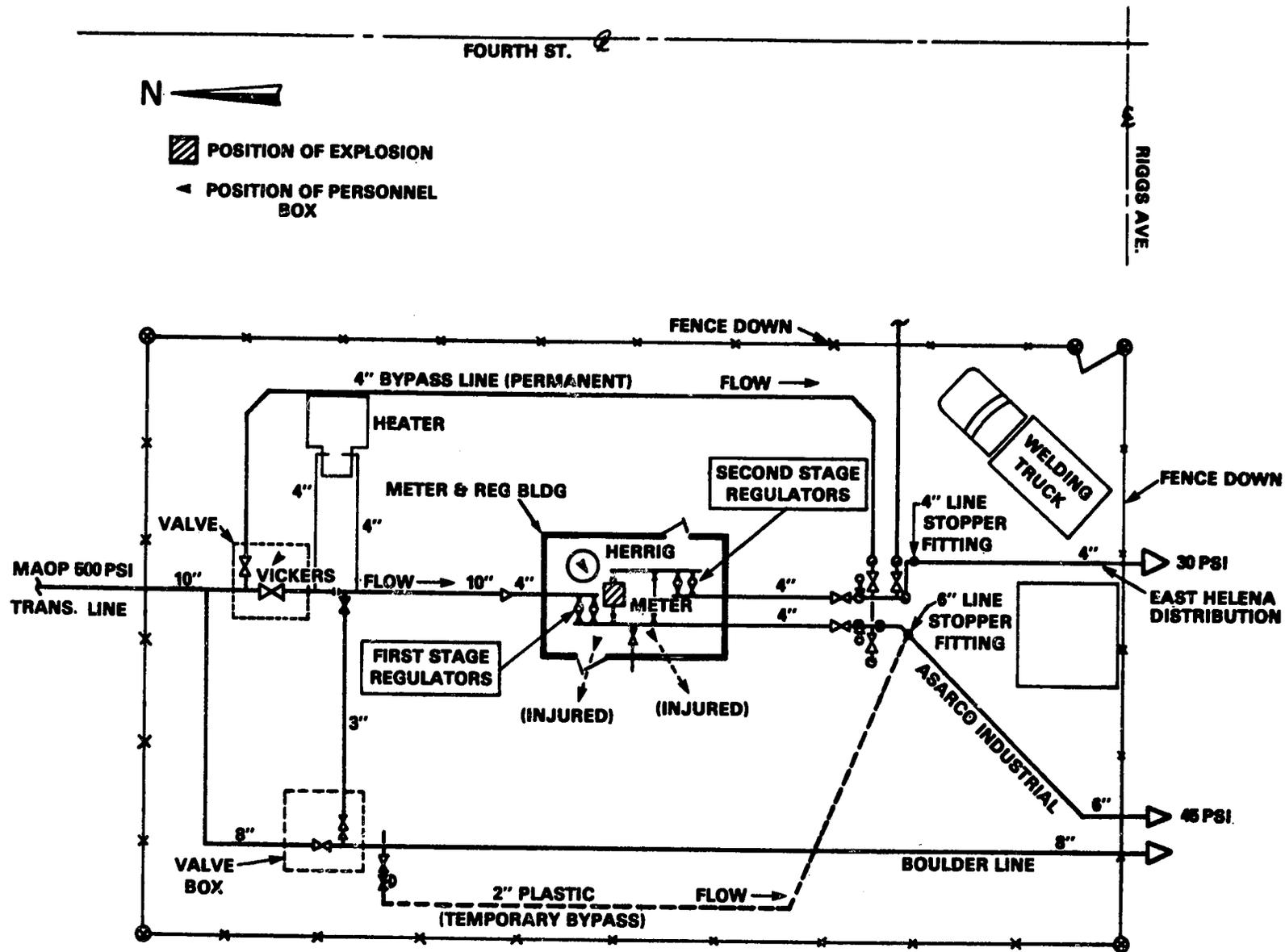


Figure 1. Plan View of Accident Site

One employee began opening a valve on the upstream side of one of the first stage regulators, and pressure began to increase. The relief valve inside the gate station vented and at this point its pressure gauge indicated 60 psig; however, the pressure gauge on the header downstream of the first stage regulators showed only 30 psig (this gauge which continued to read 30 psig after the accident was later found to be defective). The pressure continued to increase and after one of the employees noticed a pressure of over 80 psig, the entire top portion of the meter blew off killing one employee while he was looking at the recording gauge located on top of the meter.

No other property was damaged as a result of this blowout. The East Helena gas distribution system was at no time overpressured and no customers were without service. There was no fire.

After the accident, it was found that the 1/4-inch supply valve on the control line to the first stage regulators was closed. This prevented the regulator from controlling the pressure. Capacity of the first stage relief valve was not adequate to relieve transmission line pressure, and pressure increased to more than 100 psig, as indicated on the recording chart on the pressure volume gauge on the meter.

Because the gas company employees failed to open the supply valve on the control line to the first stage regulators, after purging the line the regulators were isolated from the line and a rapid increase in pressure occurred. This triggered the venting of the relief valve located inside the gate station and downstream of the first stage regulator. During a postaccident test, the relief valve functioned at 73 psig, close to its set pressure of 75 psig, but its capacity was not sufficient to prevent the pressure buildup which blew out the meter.

Had a gas employee, when the pressure reached 80 psig, closed the inlet valves to the first stage regulators, this accident could have been avoided.

Investigation of this accident revealed that the gas company personnel were not familiar with the facilities located at the gate station. Because of a lack of training and because of the lack of written procedures in the operation of the gate station, gas company personnel inadequately performed their duties, especially when the pressure reached a critical point. Proper training and well-defined procedures in the operation of the gate station could prevent similar accidents from occurring.

The company prepared written procedures for the operation of its gate stations after the accident. These procedures have been followed during the on-site training given gas company personnel, which is repeated periodically.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Accident No.:	FTW 80-FP-004
Company:	Elizabethtown Gas Company
Location of Accident:	Trenton Avenue at Elizabeth River Bridge Overpass, Elizabeth, New Jersey
Time:	9:10 a.m., e.d.t.
Date:	July 31, 1980
Property Damage:	\$300 (estimated)
Injuries:	1 fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by a workman's tools of an accumulation of natural gas in a bellhole.

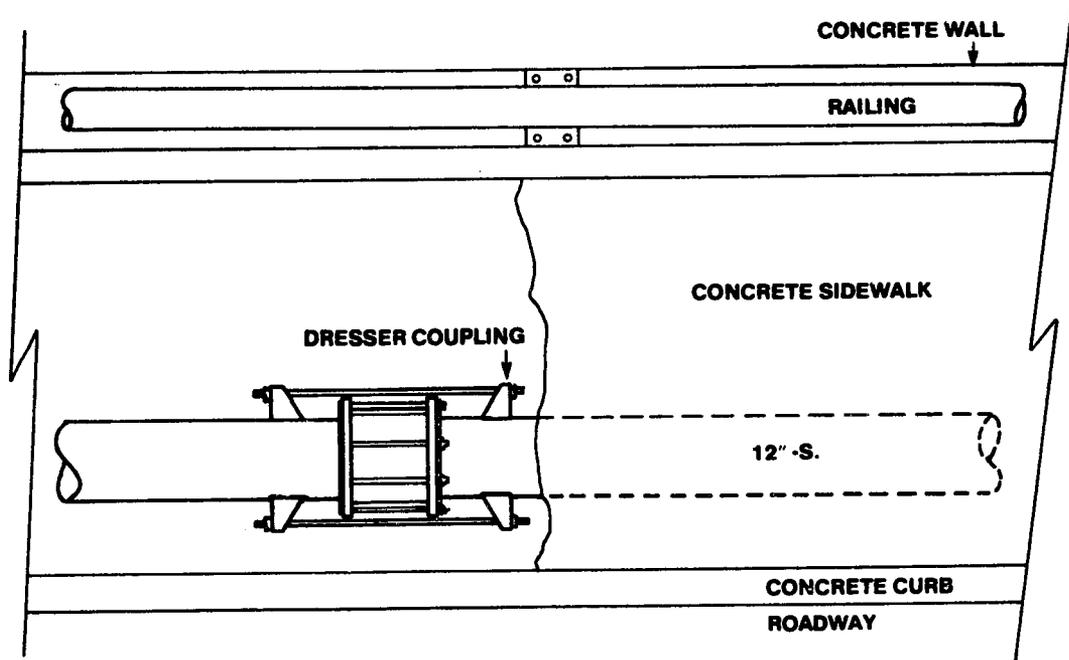
Description of the Accident

On July 31, 1980, about 9:10 a.m., an accumulation of natural gas ignited at a construction site on the Elizabeth River Bridge Overpass in Elizabeth, New Jersey. One worker was burned by the resulting fire and died 11 days later. The Safety Board investigation disclosed the following circumstances leading up to the accident.

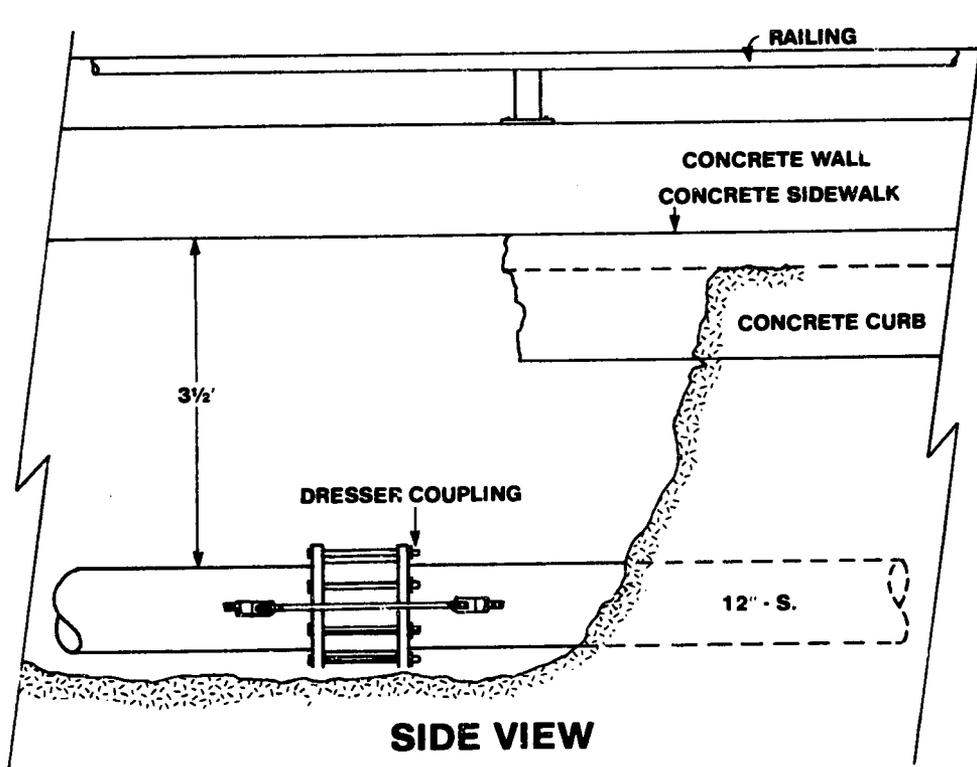
In order that the Army Corps of Engineers could raise the Trenton Avenue Bridge over the Elizabeth River, the Elizabethtown Gas Company had to temporarily abandon a 2,000-foot section of 12-inch steel gas main. (See figure 1.) On July 29 and 30, a section of the main, which normally operated at 23 psig, was isolated by closing 12-inch valves on both sides of the bridge. Gas was then vented to the atmosphere. On July 31, a three-man crew consisting of a foreman and two workers from a firm contracted by the Elizabethtown Gas Company to work on the abandonment project was at work on the Trenton Avenue Bridge. Shortly after 9:00 a.m., after a brief visit by an Elizabethtown Gas Company inspector, the foreman instructed the two workmen in the crew to loosen the 8-bolt Dresser coupling 1/ on the 12-inch main, which coupling was located at a depth of 32 inches in a bellhole. (See figure 2.)

Upon smelling gas, however, the foreman ordered the workers to leave the ditch. Before leaving the worksite, the foreman instructed the workers to let the remaining gas, which was near atmospheric pressure, dissipate before going back into the trench. Soon after the foreman left, both men reentered the open trench, but one returned to the service truck to get a tool. At this time, seven of the eight nuts and bolts on the Dresser coupling had been removed. As the workman who remained in the trench tried to remove the eighth nut and bolt with a hammer and chisel, the natural gas ignited, sparks from the hammer and chisel apparently were the source of the ignition. The workman in the trench was burned critically. He died 11 days later.

2/ Dresser Coupling - a gasketed fitting used to join pipe ends by compression.



TOP VIEW
SCALE 1/2" = 1 FT.



SIDE VIEW

**FIGURE 2. VIEWS OF BELLHOLE
ELIZABETH, NEW JERSEY**

The configuration of the bellhole -- partially enclosed by an undercut sidewalk and a trench over 4 feet deep -- provided an enclosed space in which the explosive gas-air mixture accumulated. Although near-atmospheric pressure existed in the 12-inch main, sufficient gas escaped from the loosened Dresser coupling to reach a critical level within the confined trench. The foreman recognized this, but the workmen, for reasons unknown, ignored his instructions to stay out of the trench while gas fumes were detectable.

Inadequate safety procedures, including the lack of gas monitoring equipment, the failure to take measures to avoid ignition and the lack of proper supervision, were factors that contributed to the severity of the accident. The company's postaccident conclusion to possibly require "all bolts on a coupling be loosened before any bolts are removed," is much too limited a countermeasure, for it addresses only a single factor involved in this particular accident.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.:	FTW 81-FP-006
Company:	Natural Gas Pipeline Company of America
Location of Accident:	Eugene Island Block 295-Gulf of Mexico
Time:	4:45 p.m., c.s.t.
Date:	January 27, 1981
Property Damage:	\$953,859
Injuries:	None

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the rupture by the net of the shrimper GULF KING of a 2-inch bypass line on a 16-inch natural gas transmission pipeline.

Description of the Accident

On January 27, 1980, the rupture of a bypass line that was part of a subsea tie-in unit owned, operated and maintained by the Natural Gas Pipeline Company of America (Natural) near the Exxon Company USA (Exxon) Eugene Island Block 295 platform in the Gulf of Mexico leaked about 44,454 Mcf of natural gas at 980 psig into the surrounding water, resulted in almost \$1 million in property damage. The Safety Board investigation disclosed the following circumstances leading up to the accident.

On January 27, 1980, about 4:45 p.m., the net of the shrimper GULF KING, which was trawling in 210 feet of water near Exxon's Block 295 platform, snagged the 2-inch valve on a bypass assembly on Natural's subsea tie-in. The horizontal bypass piping bent upward at an angle of 90 degrees, and the weldolet between the 2-inch and a 12-inch pipe cracked. Escaping gas created a 400-foot surface boil. The GULF KING operator reported the leak to personnel on the Exxon's 295 platform. They, in turn, notified the United Gas Pipeline Company (United), operator of the Sea Robin Pipeline, and Natural.

Natural's 16-inch pipeline ties into the Sea Robin Pipeline in Eugene Island Block 295. Installed in 1978 with a fabricated tie-in assembly, the pipeline reduces from 16 to 12 inches with a check valve and a ball valve. The 12-inch line then teed into a 12-inch side tap unit on top of the 24-inch Sea Robin Pipeline. The 2-inch bypass around the check valve which was damaged was parallel to the 12-inch pipe to which it is joined by weldolets 4 feet off the bottom of the Gulf. Because the water depth was greater than 200 feet, burial of the installation was not required. Located on Bureau of Land Management right-of-way, the installation was designed and constructed in accordance with the requirements of Title 49 CFR Part 192.

Upon notification of the leak, Natural shut in or diverted production on all platforms in the Sea Robin Pipeline system. About 46 hours after the accident, United, which had sent divers to inspect the line, informed Natural that the leak was in the Sea Robin 16-inch line and that they had it isolated by closing the subsea valve. Consequently, Natural reopened its production lines feeding the 16-inch pipeline. The leak age resumed, so once again Natural shut in its production. Finally, more than 48 hours after the accident, United divers discovered the break in the 2-inch bypass around Natural's check valve.

The 2-inch bypass assembly was the only part of Natural's subsea tie-in unit exposed and thus vulnerable to damage. Normally, shrimpers do not trawl in water depths of 210 feet. In fact, burial of pipeline is not required in water depths greater than 200 feet. However, to preclude any similar occurrence, sand bags were placed over the bypass assembly when the sidetap unit was replaced.

The loss of the estimated 44, 454 Mcf of natural gas was due to the size of the break, operating pressure of 980 psig and the time involved in shutting down the system, which time itself was a function of the difficulty in pinpointing the leak in inclement weather. Much of the high cost of the repair was due to the offshore location of the break which necessitated additional expenditures for the use of a lay barge, divers, helicopter service and marine surveyors.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

PIPELINE SUMMARY REPORT

Pipeline Accident No.: FTW 81-FP-008
Company: Alabama Gas Corporation
Location of Accident: Homewood, Alabama
Time: 1:50 p.m., c.s.t.
Date: March 3, 1981
Property Damage: \$147,000
Injuries: 0

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by a pilot light of natural gas escaping at 11 psig pressure from a 1 1/4-inch steel service line. Contributing to the accident was the failure of the contractor to request the gas company to locate its facilities before grading operations were begun.

Description of the Accident

On March 3, 1981, about 2:10 p.m., a natural gas explosion leveled a private residence in Homewood, Alabama, a suburb of Birmingham, Alabama. No injuries resulted directly from the explosion. The Safety Board investigation disclosed the following circumstances leading up to the accident.

The owner of a private residence in Homewood, Alabama contracted with a construction company to install a driveway on his property. On the afternoon of March 3, an employee of the construction company was grading the area to be paved with a backhoe-loader. According to the homeowner, any trees to be removed were to be sawed off at ground level and the stumps paved over. However, during the grading operation, about 1:50 p.m., the backhoe operator toppled a 15-inch diameter pine tree.

As the tree was uprooted, a 1 1/4-inch bare steel service line, which passed through the tree's root system was pulled from its threaded connection in a service cock in the basement wall; the meter set assembly dropped to the basement floor, and natural gas began leaking into the basement at 11 psig. The service line also separated partially at the point the tree was uprooted, so natural gas also began leaking to the environment.

Smelling the gas odor near the uprooted tree, the backhoe operator notified the Alabama Gas Corporation at 1:58 p.m. that the service was "leaking pretty bad." At 2:04 p.m., gas company personnel were dispatched to the scene to repair the leak; however, before they arrived 10 minutes later, the gas in the house ignited and exploded at 2:10 p.m. Gas buildup in the basement had reached the explosive level over a 20-minute period and had been ignited by the pilot light of either the gas furnace or gas water heater.

The service line was installed in 1948, and entered the basement 18 inches below ground level where it was connected to a valve and a meter set assembly. The regulator was vented to the outside with a 1/2-inch line, which was hard to discern. Construction company personnel had made no attempt to locate the gas facilities before beginning the driveway construction, although the City of Birmingham, of which Homewood is a suburb, has a voluntary one-call system to provide information to those who might encounter utility facilities. More readily visible gas facilities, such as an outside meter set assembly, or construction company coordination with the Alabama Gas Corporation to locate gas facilities could have prevented the accident.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Accident No. FTW 80-FP-007
Company: Lone Star Gas Company
Location: Keller, Texas
Time: 9:56 p.m., c.d.t.
Date: September 28, 1980
Damage: \$41,000
Injuries: 1 fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of natural gas from a leaking standard compression coupling on a 1-inch steel service loosened by soil movement.

Description of Accident

At 9:56 p.m., c.d.t., on September 28, 1980, a natural gas explosion in Keller, Texas, destroyed one private residence and fatally injured the lone occupant. (See figure 1.) The Safety Board investigation disclosed the following circumstances leading up to the accident.

In September 1950, Lone Star Gas Company installed a long-side 1-inch steel service line 40 inches beneath Price Street in Keller, Texas to provide service to a private residence. About 20 years later, when that residence was razed, the service was abandoned at the stub end of the line. Service was not abandoned at the main to allow for any future need for gas service. It was at this connection with the main that the leak developed. The service line was attached to the service tap with a 90° elbow, a street elbow, a short nipple and a 1-inch by 5 1/2 inch standard compression coupling. Gas leaked at 15 psig from the inlet side of the coupling which had pulled loose from the nipple.

The standard compressions coupling was not designed to prevent pullout. However, only since 1974 has the manufacturer cautioned users to properly anchor the pipe where the possibility of pipe movement exists. The service line beneath Price Street was not anchored.

A long period of near-record drought followed by sustained, heavy rain preceded the accident. The clay soil in which the pipe was buried contracts when dry and expands when wet. This soil movement subjected the underground piping to stress and resulted in the loosened coupling. The Lone Star Gas Company reported 5 additional accidents in the general area within a two-week period, in all of which the pipe and fitting were stressed by soil movement.

Besides contributing to loosening the coupling, the wet clay also kept the natural gas escaping from the coupling from migrating upward. As a result, the gas moved laterally, beneath and then upward into the nearby house, where it ignited by an undetermined source.

Had the service line been abandoned at the main when it became apparent no future need for service would arise, the hazard would have been eliminated. Similarly, pipe installation with proper anchorage would have reduced the possibility of a loosened coupling and concomitant gas leak.

The Safety Board, as a result of its investigation of a similar accident, 1/recommended that the Research and Special Programs Administration:

Initiate rulemaking to prescribe a time limit when an inactive service line would be required to be abandoned and physically disconnected from the main. (Class II Priority Action) (P-80-74)

The status of this recommendation is open, pending response from the Research and Special Programs Administration.

1/ Pipeline Accident Reports -- Brief Format, Issue #1-1980, page 23 -- Central Louisiana Electric Company, Inc., Lafayette, Louisiana, August 7, 1978.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: FTW 81-FP-005
Company: Missouri Power & Light Company
Location of Accident: Mexico, Missouri
Time: 10:15 p.m., c.s.t.
Date: January 8, 1981
Property Damage: \$200,000
Injuries: 3 nonfatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition by an undetermined source of an accumulation of natural gas which migrated into a building from a leak at a standard compression coupling which had been pulled loose but not separated by thermal contraction of unrestrained polyethylene pipe.

Description of the Accident

At 10:15 p.m., c.s.t., on January 8, 1981, a 2-inch plastic gas main pulled loose in a compression coupling under an alley in downtown Mexico, Missouri. Natural gas at 43 psig pressure escaped from the main and migrated through a sanitary sewer system into a nearby building where it was ignited by an undetermined source at 10:25 p.m. The resulting explosion and fire destroyed a commercial building, severely damaged an adjacent building, broke nearby windows, and damaged several motor vehicles. The fire was confined to the area. There were no fatalities; however, three firemen were injured while fighting the blaze.

At 10:33 p.m., the Mexico Department of Public Safety notified the Missouri Power & Light Company dispatcher in Moberly, Missouri, of the accident. Utility company personnel were dispatched to the scene. When the assistant superintendent arrived at the accident site, he saw flames rising in the alley behind the burning buildings. At 11:15 p.m., he closed a valve through a curb-box some 200 feet upstream of the leak which shut off the gas flow on the one-way feed. Excavation of the leak area began at midnight. Repairs were completed by 3:00 a.m., and service was restored by 4:00 a.m.

After the accident, the main was exposed in a bell hole to the transition connection of 4-inch steel pipe and 2-inch polyethylene pipe which had been made with two compression couplings and a 10-inch-long segment of 2-inch plastic pipe. The leak was found at the upstream end of the downstream coupling had been loosened by pullout forces that the coupling had not been designed to restrain.

In the mid-1950's the Missouri Power & Light Company had extended a 4-inch, cast-iron main in the alley to serve a laundry. Sometime later a section of the cast-iron main was replaced with a 4-inch steel pipe. In 1974, the gas company began using polyethylene pipe and its personnel were trained and tested by the pipe manufacturer in the fusion of the plastic and other procedures involving its installation. In February 1975,

2-inch polyethylene plastic pipe was inserted into the remaining 170 feet of cast-iron pipe. The length of the plastic pipe was misjudged and an additional 10-inch piece of plastic pipe and two standard, short-barreled compression couplings with smooth liners were used for the connection.

More recently all high-pressure installations have been made with "Posi-Hold" couplings, but previously their use had been limited in the gas company's Mexico district because only one set of equipment was available for such installations.

The Safety Board has investigated two similar accidents ^{1/} involving transition couplings joining polyethylene plastic pipe to steel pipe. In both accidents, over 100 feet of unrestrained polyethylene pipe had been inserted in an abandoned main and had been joined to the steel pipe with a standard, short-barreled compression coupling with a smooth metal insert. The failures were caused by thermal contraction of the polyethylene pipe which exerted pullout forces on the compression couplings which they were not designed to resist.

The city of Mexico is served by Panhandle Eastern Pipe Line Company's single city gate station with dual orifice meter runs. The increased rate of flow which occurred when the coupling failed was apparent on the telemeter charts--which show proportional flow--in the Mexico Service Center which is unmanned after normal working hours. A decreased rate of flow was also evident when the valve was closed 45 minutes after the accident. The event was also recorded on a pressure chart at a regulator station 4,500 feet from the leak. Comparable data elsewhere in its system has been used by Missouri Power & Light to detect leaks, which assured their timely repair.

As a result of its investigation of this accident, the National Transportation Safety Board issued the following recommendations on August 3, 1981, to the Missouri Power & Light Company:

Review company records and maps to identify locations where compression couplings have been installed on unrestrained plastic pipe of sufficient length that thermal contraction could cause separation from the couplings and take corrective action as necessary to prevent such separations. (Class II, Priority Action) (P-81-21)

Install alarms on the existing gas pressure and gas flow telemetering equipment to promptly alert operators to emergency conditions such as linebreaks which are evidenced by abnormally high gas flow rates or pressure reductions. (Class II, Priority Action) (P-81-22)

The status of these recommendations is open, awaiting response, as of March 3, 1982.

^{1/} Pipeline Accident Report--"Nebraska Natural Gas Company, Pathfinder Hotel Explosion and Fire, Fremont, Nebraska, January 10, 1976" (NTSB-PAR-76-6); and Pipeline Accident Report--"Kansas Public Service Company, Inc., Explosion and Fire, Lawrence, Kansas, December 15, 1977" (NTSB-PAR-78-4).

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.:	FTW 78-FP-008
Company:	Oklahoma Natural Gas Company
Location of Accident:	Oklahoma City, Oklahoma
Time:	3:50 p.m., c.s.t.
Date:	April 24, 1978
Property Damage:	None
Injuries:	4 Fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the displacement of air from a regulator vault by natural gas escaping from a disconnected service line, which resulted in an oxygen-deficient atmosphere, and the fatal asphyxiation of four men. Working in the confined vault without stopping the flow of gas and attempting rescue operations without the use of safety devices and following proper safety procedures contributed to this accident.

Description of Accident

On March 29, 1978, Oklahoma Natural Gas Company (ONG) dispatched a two-man crew to shut off gas service to a shopping center in Oklahoma City at a regulator vault in order to repair customer service lines. Because the crew was unable to close a valve that was under water inside the vault upstream of the regulator, they disconnected the line on the low-pressure side of the regulator at a 2-inch union and plugged the line without first stopping the flow of gas. Another valve was located outside the vault, but because it was paved over with asphalt, the crew did not attempt to uncover it.

On April 24, 1978, ONG assigned a different crew to restore gas service to the shopping center. This two-man crew was not able to close the valve inside the vault because it was still under water, and they did not try to uncover the valve outside the vault. Instead, the crew removed the plug and stuffed the line with a rag to stop the gas flow. When the crew removed the rag, they were unable to immediately align the union to start the threads, and gas began escaping at a pressure of 9 inches W.C. The escaping gas filled the 3- by 4- by 6-foot vault and within minutes the two men were asphyxiated. Three other ONG employees entered the vault through the 19-inch opening to rescue the men. Shortly thereafter, one man was pulled out of the vault by other ONG workers and was revived at the scene; however, the other four men died of asphyxiation. The crew did not have a respirator at the job site.

A mainline valve finally was turned off, and rescue personnel with air packs arrived and removed the asphyxiated men from the vault. The five men in the vault had been employed by ONG an average of 20 years; three of the men were supervisors. Although ONG has trained its men in the use of air-breathing masks, ventilators, and lifebelts, the company does not have written instructions about where this safety equipment should be used.

The ONG workmen did not stop the flow of gas before disconnecting the 2-inch union in the vault by either pumping the water out of the vault to make the valve operable, or by uncovering the valve outside the vault. The crew did not use any safety equipment during their attempt to restore gas service nor did they follow any unwritten safety procedures in their subsequent rescue attempt. Working in the confined vault without stopping the flow of gas, and attempting rescue operations without the use of safety devices and following proper safety procedures were factors contributing to this accident.

The Safety Board has investigated similar accidents involving gas company employees who were overcome by gas while working in a vault, two of which are referenced. ^{1/} In a number of cases, senior gas men who were acquainted with the hazards of natural gas were involved in these accidents.

The National Transportation Safety Board, as a result of its investigation of this accident, recommended that the Oklahoma Natural Gas Company:

Require its employees to use valves or other means to stop the flow of gas before disconnecting or reconnecting active gas lines. (Class I, Urgent Action) (P-78-53)

In training both new and long term employees, emphasize the need to have available safety equipment while performing certain hazardous work in confined spaces and the importance of testing the atmosphere, the use of safety devices, and the use of safe procedures. (Class I, Urgent Action) (P-78-54)

Revise its safety manual to include written instructions on where and how to use safety equipment as an on-the-job complement to existing training activities. (Class I, Urgent Action) (P-78-55)

The status of these recommendations is closed, acceptable action, as of December 19, 1978.

^{1/} "Pipeline Accident Report--Equitable Gas Company, Pittsburg, Pennsylvania, November 17, 1971," (NTSB-PAR-72-2); National Fuel Gas Company accident, Buffalo, New York, March 26, 1977.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.:	FTW 81-FP-004
Company:	Cincinnati Gas & Electric Company
Location of Accident:	515 W. Columbia Avenue, Reading, Ohio
Time:	1:00 - 3:00 p.m., c.s.t.
Date:	December 17, 1980
Property Damage:	None
Injuries:	2 Fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the use of improper fittings by the gas company crew in making a service tap which allowed the escape of natural gas and resulted in the fatal asphyxiation of two men in an oxygen-deficient atmosphere .

Description of Accident

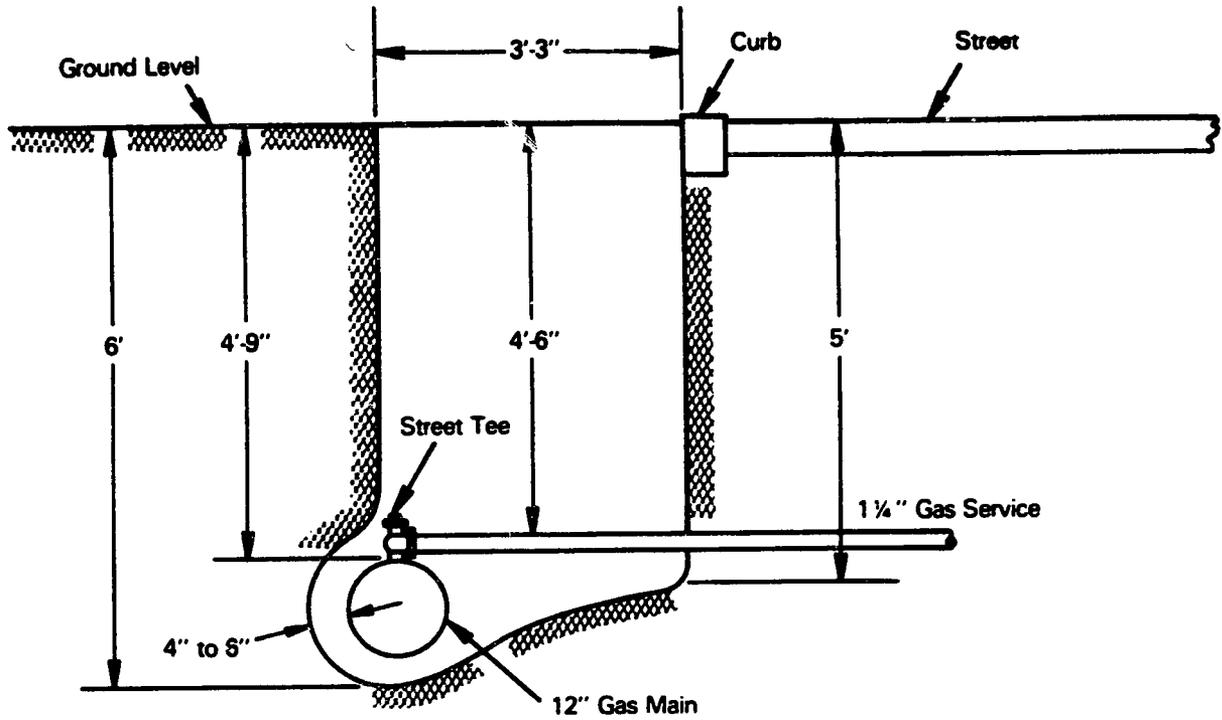
At 9:00 a.m., c.s.t., on Wednesday, December 17, two mechanics were at a job site on the north side of the street discussing with their supervisor the fittings to be used for a gas service line renewal. The supervisor radioed for shoring material when he noted that they had none, and he instructed the senior mechanic not to enter the bellhole until the shoring was installed. The men further discussed the 12-inch main, which was steel pipe on a nearby bridge crossing, but which might be made of cast iron at the service tap. The service line was pressure tested from the curb to the meter and found to be leaking. The gas customer's son last saw the two men at 12:45 p.m. standing by the service tap bellhole. When he returned home at 3:00 p.m., he noticed gas blowing from the bellhole; he did not notify the Gas Company.

Just before 1:00 p.m., a postman noticed discolored air rising from the bellhole, but saw no one there. About 1:00 p.m., after parking on the south side of the street in front of the residence served by the line being renewed, he noticed one of the Gas Company employees "standing in the excavation (across the street) with his head turned to one side and waving his arms while it appeared that he was gasping for air." The postman after observing what must have been an unsuccessful attempt by the man to escape from the hole, delivered mail to the residence and then returned to his vehicle. At this time, he saw no one. He drove around the corner and parked for 12 minutes. When he departed at 1:15 p.m., no one was visible at the excavation; he did not notify the Gas Company.

At 3:10 p.m., a gas company employee passed the location, saw the Construction and Maintenance truck (with its ladder still in place), smelled gas and heard it blowing. When he stopped to investigate, he found the two men in the bellhole. After he unsuccessfully attempted to pull one out by himself, he radioed the dispatcher. When help arrived at 3:15 p.m., the men were removed from the bellhole and taken to a hospital. Resuscitation efforts commenced at the scene and continued until they were pronounced dead of asphyxiation at the hospital.

Gas Company Emergency crews were dispatched to the accident site. Pressure was reduced to 5 psig. The service tap bellhole, in which no shoring had been installed, was 31 inches by 39 inches and 5 feet deep. (See figure 1.) After the bellhole was enlarged with a backhoe, the main was checked with a chisel and found to be cast iron (this was also indicated on the records). Two other chisel marks were subsequently found. A 12-inch by 1-inch steel Skinner-type saddle was partially around the main over a 1 1/4-inch hole. The saddle bolt was loose and the rubber gasket was protruding from one side. Gas was escaping from beneath the saddle and around the gasket. The saddle was designed for use on a steel main and consequently did not fit the cast iron main properly because the outside diameter of the cast iron main was larger than that of a 12-inch steel main. After the saddle was removed, the gas flow was stopped by the use of a 1 1/4-inch plug which was "threaded easily into the main (approximately 2 to 3 seconds)." A saddle was not needed since the crew used a 1 1/4-inch by 1-inch brass street tee with a 1-inch brass 90° compression anti-pullout ell. The job was completed by inserting the old service line with 1-inch plastic.

The employees' records indicated that both men initially sent to the site had received classroom and field training when they were first employed and at later times in preparation for promotion. They were required to pass tests upon completion of training, and their work was subsequently inspected on a number of occasions. Such training was intended to adequately prepare them to safely execute this type of job.



Section A-A
Scale: 1/2" = 1'-0"

Accident Site — Bellhole at
Long-Side Service Tap for
515 W. Columbia Ave.,
Reading, Ohio

Figure 1.

C.G. & E. Co.
By: G. Kennedy
Date: 1-16-81
Doc. No. a

Note: Dimensions Are Approximate

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Pipeline Accident No.: FTW 81-FP-002
Company: Texas - New Mexico Pipe Line Company
Location of Accident: Eight Miles West of San Ysidro, New Mexico
Time: 5:30 p.m., m.d.t.
Date: October 22, 1980
Property Damage: \$283,600
Injuries: 1 Fatal

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition of escaping crude oil by a bulldozer as it punctured a 16-inch crude oil pipeline while cleaning the right-of-way after an adjacent pipeline was installed.

Description of Accident

At 5:30 p.m., m.d.t., on October 22, 1980, 8 miles west of San Ysidro, New Mexico, a 16-inch crude oil trunkline operating under a static pressure of 400 psig, was punctured when struck by a bulldozer. The dozer operator was fatally injured by the resulting fire which consumed over 5,000 barrels of crude oil that had leaked through the puncture.

The Texas-New Mexico Pipeline Company's 16-inch steel pipeline carried crude oil from Aneth, Utah, to Jal, New Mexico, a distance of 512 miles. It shared a right-of-way (ROW) in the area of the accident with Mid-America Pipeline Company (MAPCO), whose contractor was constructing an additional liquid hydrocarbon pipeline. Although the lines generally ran parallel to each other, they did cross several times. Work on the new MAPCO line had been in progress for about 30 days over about 90 miles of parallel construction which had been completed at the time of the accident. In the immediate vicinity of the puncture, MAPCO's new pipeline had already been installed and backfilled. The bulldozer operator, consequently, should have been thoroughly aware of the existence of the Texas - New Mexico 16 -inch crude oil trunkline. Also, there was no reason for cutting below grade where the new pipeline had already been installed; and the bulldozer operator had been instructed not to clear the ROW. The new line was located between the two existing lines--10 feet from MAPCO's existing line and about 35 feet from Texas-New Mexico's 16-inch pipeline. An engineer from the Aneth Station was serving as Texas-New Mexico's inspector during the construction of MAPCO's new pipeline.

The accident happened at 5:30 p.m. when the pipeline contractor's bulldozer was cleaning the ROW on a steep slope below the top of a mesa on Zia Pueblo land at milepost (MP) 183.2. A corner of the dozer blade punctured the 16-inch trunkline which contained West Coast Sweet Crude Oil, with an API gravity of 36.2 degrees, under a static pressure of 400 psig. The oil ignited, burning the dozer operator and the dozer. Most of the 5,684 barrels of crude oil that escaped were consumed by fire which burned about 800 feet down the slope. The operator's body was found 35 feet from the bulldozer, which was still in contact with the pipeline although it had been shifted into second reverse in an apparent attempt to escape.

At 11:35 a.m., the upstream Bisti Station (MP 87.5) was shut down awaiting pumping orders. The line was closed at the downstream Lynch Station (MP 473.49) at 1:32 p.m. The high point on the line upstream of the accident was at the Continental Divide (MP 131.5).

At 5:30 p.m., the Aneth Station (MP 0.0) received a low-pressure alarm indication from a block valve at the Rio Grande River crossing (MP 208.9), downstream of the break. Six minutes later, the Aneth Station received a valve-closed alarm indication from the Rio Grande block valve. Aneth was notified of the accident by the pipeline contractor at 6:00 p.m. Shortly thereafter, the first Texas-New Mexico personnel were dispatched, and began accumulating information and developing plans.

The fire had nearly burned itself out by midnight and it was apparent that there was no danger of stream pollution. A pipeline contractor, summoned by Texas-New Mexico, was on site very early the morning after the accident. Halliburton cementing trucks and equipment reached the location late that morning but were released shortly thereafter since the fire had practically burned out.

The line was tapped and stoppled the following day, and a 40-foot section was cut out and replaced. The line was repaired and refilled, and the cleanup completed. The total cost incurred by Texas-New Mexico Pipeline Company, including value of product lost, was \$258,602.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Accident No. FTW 80-FP-006
Company: Enterprise Products Company
Location: Cities Service Oil Company
Petrochemical Plant near Sulphur, Louisiana
Time: 3:40 p.m., c.d.t.
Date: September 2, 1980
Damage: Over \$100,000
Injuries: None

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the ignition of a fire that spread to a 4-inch steel propylene pipeline, which, when heated by oil-fed flames, ruptured.

Description of Accident

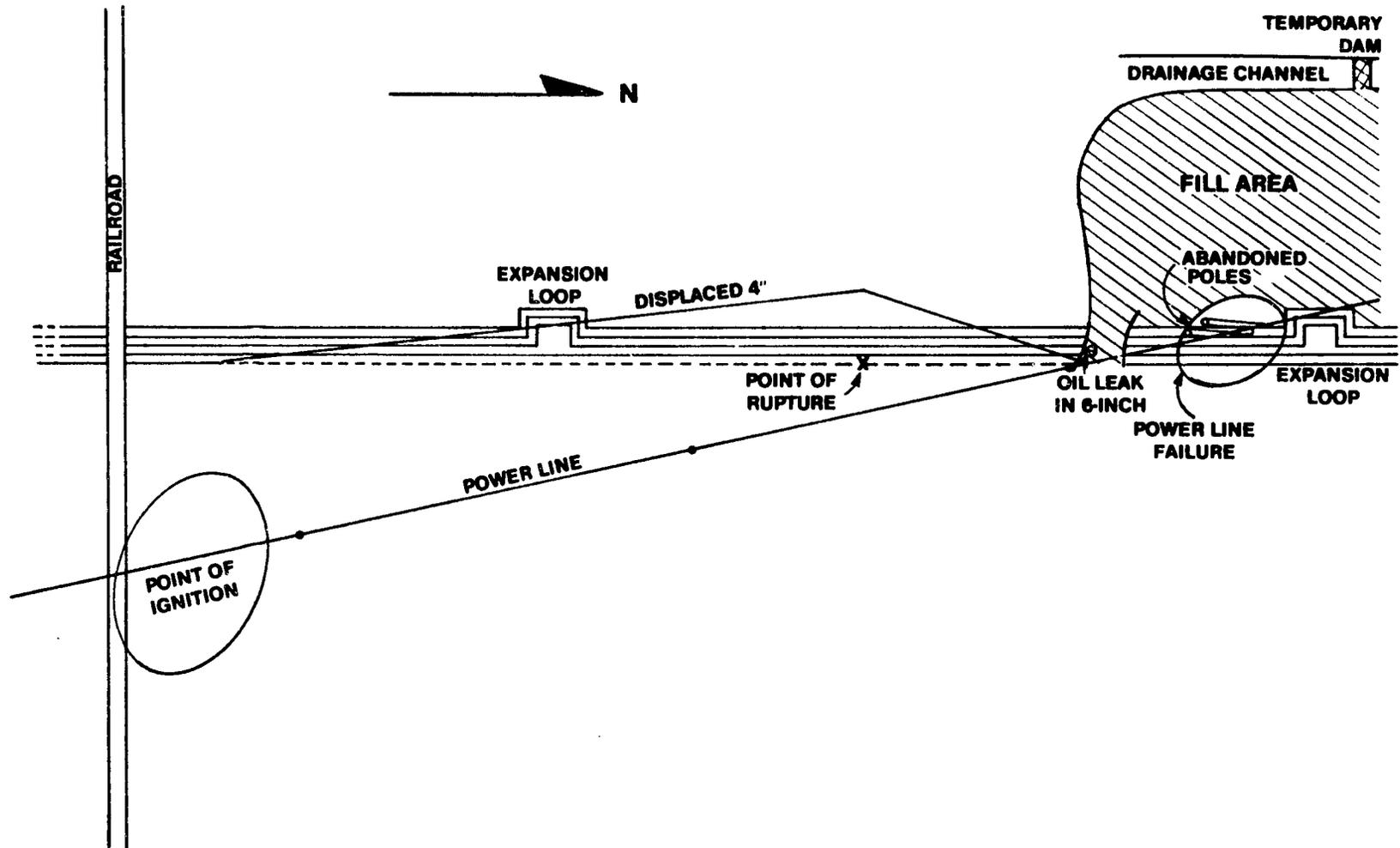
On September 2, 1980, at 3:40 p.m., a propylene pipeline owned and operated by the Enterprise Products Company (EPC) ruptured at the Cities Service Oil Company Petrochemical Plant near Sulphur, Louisiana. More than 500 feet of the pipeline were damaged and 400 barrels of product lost. Segments of 4 other pipelines owned by Continental Oil Company (CONOCO) also were damaged. The Safety Board investigation disclosed the following circumstances leading up to the accident.

On August 29, 1980, an oil leak was detected on one of CONOCO's pipelines, 175 feet north of the subsequent EPC rupture. (See figure 1.) Clean-up was deferred until after the Labor Day weekend, so a temporary dam was created to stem the oil spread. Consequently, during the next few days the oil collected in a pond created by the dam beneath a low section of elevated pipelines.

On September 2, at 2:50 p.m., a Southern Railway maintenance crew working on track about 300 feet from and perpendicular to the elevated pipelines accidentally ignited a grass fire alongside the track. A moderately strong SSE wind carried the fire into brush and trees and along a power line right-of-way which crossed the railroad and converged upon the pipelines, intersecting them about 700 feet north of the railroad tracks.

Upon reaching the oil spill, the fire fed on the oil and intensified in two critical locations: a low spot beneath the five pipelines where they were elevated on a rack 4 feet above the ground level; and a spot about 300 feet further north, where some old utility poles had been left along the pipeline right-of-way, beneath the power lines. Fueled by the burning oil and poles, the fire reached and burned through three of the overhead power lines, causing a power failure at 3:30 p.m.

As a result of the power loss, the spring-loaded actuator on the downstream block valve of the EPC's steel propylene line closed. The spring-loaded actuator was designed to fail closed. The block valve closure stopped the flow of propylene in the 4-inch pipeline, causing pressure to increase and the pipe to heat to a point of rupture. The



**FIGURE 1. PLAN VIEW OF ACCIDENT SITE
SULPHUR, LOUISIANA**

sudden release of propylene under an approximate pressure of 400 psig and its explosive ignition by the burning oil exerted intense stress on the pipe. Many of the posts on the pipe support racks loosened. About 650 feet of the 4-inch pipe whipped off the rack, with a maximum lateral displacement of 50 feet from the point of rupture. The 4-inch pipeline was damaged both by fire and displacement stress, and an estimated 400 barrels of propylene were consumed by fire.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594**

Pipeline Summary Report

Accident No.: FTW 80-FP-005
Company: Entex, Inc.
Location of Accident: Intersection of Cameron and Dulse Streets, Tyler, Texas
Time: 10:50 a.m., c.d.t.
Date: July 3, 1980
Property Damage: \$500 (estimated)
Injuries: 1 fatal
3 nonfatal

Probable Cause:

The National Transportation Safety Board determines that the probable cause of the accident was the ignition of natural gas escaping from a slide gate by electrical arcing when an engine was started.

Description of the Accident

On July 3, 1980, about 10:50 a.m., natural gas escaping from a slide gate ^{1/} at a construction site in Tyler, Texas where a gas main was being replaced was ignited by electrical arcing when an engine was started. The resulting fire burned four workmen, one of whom later died. The Safety Board investigation disclosed the following circumstances leading up to the accident.

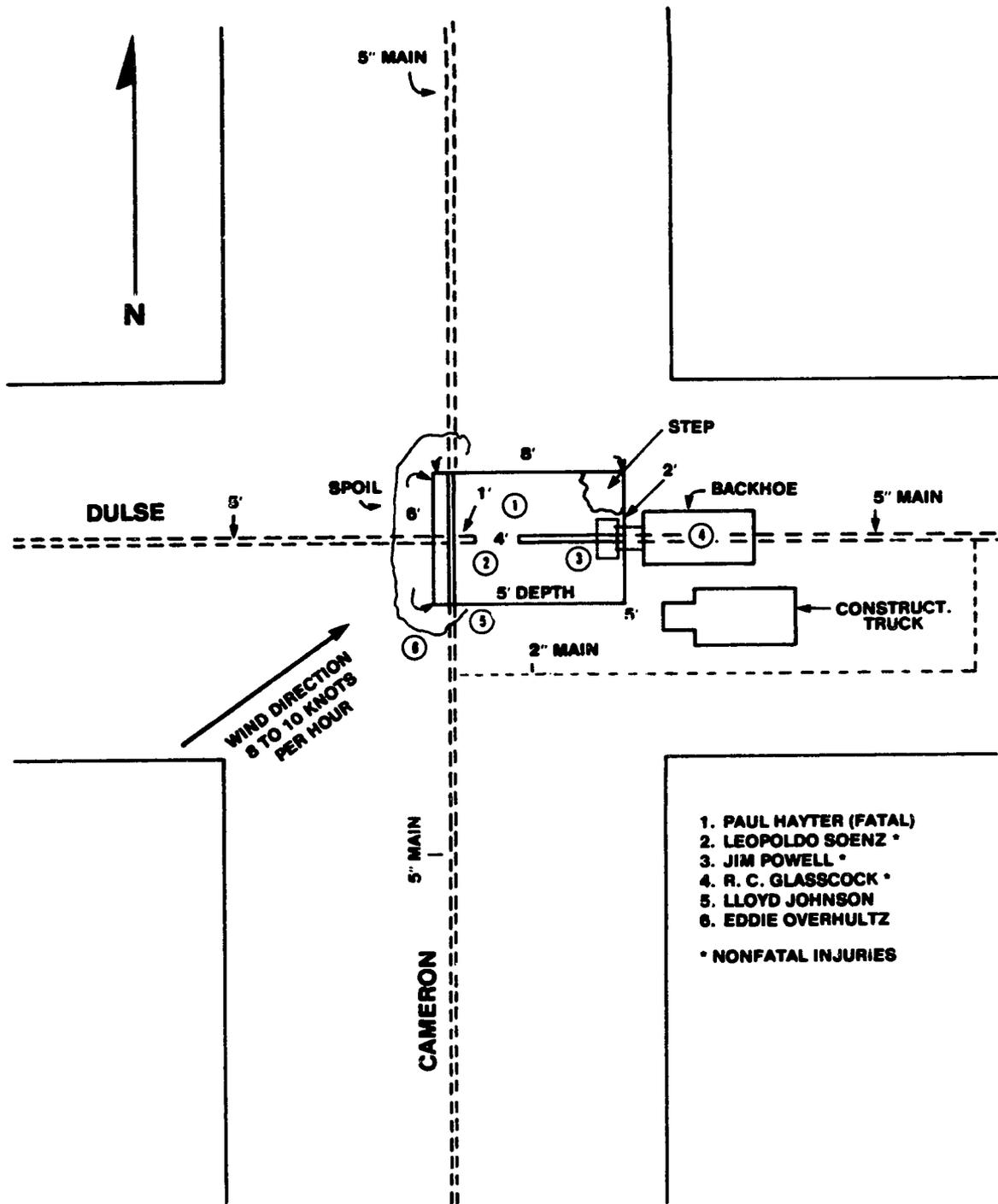
As a result of a study, the East Texas Division of Entex, Inc., decided to replace 250 feet of pipeline. When construction began, the company discovered that the gas main was not 2-inch, as was shown on company maps, but 5-inch pipe. The gas company decided to remove the 5-inch gas main while maintaining service at a reduced pressure of 7 to 8 psig through a new 2-inch pipe. (See figure 1.)

At 7:00 a.m., on July 3, a utility foreman and a five-man crew began isolating a section of the 5-inch gas main being replaced at the intersection of Cameron and Dulse Streets in Tyler. First they squeezed the east end of the gas main and locked the squeezers in place. Then they sawed a plate hole ^{2/} near the west end of the pipe to be removed and installed a slide gate. The crew then dug a 5-foot-deep bellhole at the west end of the pipe section to be removed and cut and removed a 4-foot section of pipe which was 48 inches below ground. The foreman, sitting on the backhoe, instructed the crew to remove an additional foot of pipe and reverse the bolts on a Dresser coupling ^{3/} being used to attach a cap on the end of the main. The coupling was being held in place by the backhoe bucket while the bolts were being tightened.

^{1/} Slide gate is a method of stopping gas flow by means of placing a rubber-lined clamp with a preformed slot on the main to permit sawing through the live main so that a slide may be inserted in the slot to stop the gas flow.

^{2/} Plate hole - a slot created by sawing through a live main for the insertion of a slide gate.

^{3/} Dresser coupling - a gasketed fitting used to join pipe ends by compression.



**FIGURE 1. PLAN VIEW OF ACCIDENT SITE
TYLER, TEXAS**

At 10:50 a.m., the foreman started the backhoe begin, in preparation for positioning the bucket. Electrical arcing from the starter ignited natural gas leaking around the slide gate at 7 to 8 psig. The three crewmen in the bellhole and the foreman suffered burn injuries from the resulting fire. One of the crew died later as a result of his injuries.

Use of a slide gate to stop the gas flow was not an acceptable procedure by Entex operations. Written company procedures specified the use of particular line stopping equipment. Apparently use of slide gates to isolate pipe sections had been a common practice of the Tyler Gas Service Company, the predecessor to the East Texas Division of Entex. Line stopping equipment designed to stop the gas flow in common-size mains such as 2-inch pipe was on hand. However, the slide gate was all that was readily available as a stopper for the nonstandard size 5-inch gas main.

The drawback in using a the slide gate as a line stopper is the leakage during and after installation. Nevertheless a slide gate is a commonly used device up to an upper pressure limit of 15 to 20 psig.

In this instance, though the 7 to 8 psig pressure was considerably lower than the recommended upper limit of 15 to 20 psig, conditions were favorable to the accumulation of a combustible mixture of air and natural gas, leakage from the 5-inch main, 48 inches below ground level in a 5-foot-deep hole. The wind speed of 8 to 10 knots per hour was sufficient to carry the combustible mixture to the source of ignition.

The hazards of gas and air mixtures are addressed in the Entex "Employee Safe Work Practices Manual" which also outlines precautionary measures not followed by the work crew. It states:

"... it is essential that all possible sources of ignition be considered and controlled... Escaping gas is extremely critical and dangerous in an enclosed space such as a trench excavation... where dangerous gas and air mixtures could quickly develop. When escaping gas is known to be present, instrument tests should be made to determine its concentration. If an explosive mixture is found or if measurable quantities of gas are indicated, precautions should be taken to avoid possible ignition..."

All these elements were present at the Tyler excavation and should have alerted the crew to the need for extra caution.