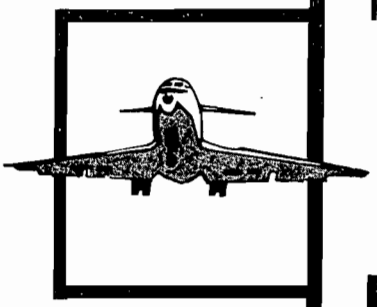
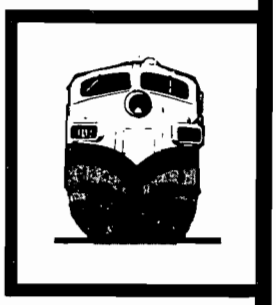
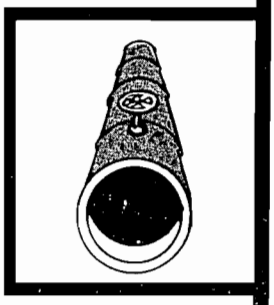
PB82-916502







# NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

## PIPELINE ACCIDENT REPORT

**THE CHAPARRAL PIPELINE,**
**EXPLOSION AND FIRE**
**ACKERLY, TEXAS**
**SEPTEMBER 27, 1981**

NTSB-PAR-82-2

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

| 1. Report No. NTSB-PAR-82-2 | 2. Government Accession No. PB82-916502 | 3. Recipient's Catalog No. |
|---|---|---|
| 4. Title and Subtitle Pipeline Accident Report-- The Chaparral Pipeline, Explosion and Fire, Ackerly, Texas, September 27, 1981 | | 5. Report Date April 20, 1982<br>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. 3498<br>11. Contract or Grant No. |
| 12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594 | | 13. Type of Report and Period Covered Pipeline Accident, Report September 27, 1981<br>14. Sponsoring Agency Code |

15. Supplementary Notes

16. Abstract

At 1:38 p.m., c.d.t., on September 27, 1981, near Ackerly, Texas, the Chaparral Pipeline, a refined petroleum products 12-inch steel pipeline owned by the Santa Fe Pipeline Company, was damaged by a rathole drill bit; the wall of the pipe was weakened, and it ruptured under the 1,100 psig operating pressure. The ethane-propane mixture in the pipeline began to escape and was ignited by the drilling rig engine. The ensuing explosion and fire killed three persons; critically burned one person, who died 4 days later; destroyed the rathole drilling rig, a pickup truck, a road grader, a compactor, and 60 acres of cotton; and burned 12,749 barrels (535,458 gallons) of ethane-propane mixture.

The National Transportation Safety Board determines that the probable cause of the accident involving the rupture of a 12-inch products pipeline, which was damaged when struck by a rathole drill, was the failure of the oil company to determine the existence of the pipeline before drilling operations began.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| E-P Mix, drilling rig, rathole, mousehole, cellar, staking well location, caliche, pipeline marker, pipeline surveillance, milepost, manual valve, suction valve, supervisory control system, one-call system, rapid shutdown | This document is available to the public through the National Technical Information Service Springfield, Virginia 22161 |

| 19. Security Classification (of this report) | 20. Security Classification (of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | 27 | |

NTSB Form 1765.2 (Rev. 9/74)

CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

PIPELINE ACCIDENT REPORT

Adopted: April 20, 1982

# THE CHAPARRAL PIPELINE EXPLOSION AND FIRE ACKERLY, TEXAS SEPTEMBER 27, 1981

## SYNOPSIS

At 1:38 p.m., c.d.t., on September 27, 1981, near Ackerly, Texas, the Chaparral Pipeline, a refined petroleum products 12-inch steel pipeline owned by the Santa Fe Pipeline Company, was damaged by a rathole drill bit; the wall of the pipe was weakened, and it ruptured under the 1,100 psig operating pressure. The ethane-propane mixture in the pipeline began to escape and was ignited by the drilling rig engine. The ensuing explosion and fire killed three persons; critically burned one person, who died 4 days later; destroyed the rathole drilling rig, a pickup truck, a road grader, a compactor, and 60 acres of cotton; and burned 12,749 barrels (535,458 gallons) of ethane-propane mixture.

The National Transportation Safety Board determines that the probable cause of the accident involving the rupture of a 12-inch products pipeline which was damaged when struck by a rathole drill, was the failure of the oil company to determine the existence of the pipeline before drilling operations began.

## INVESTIGATION

### The Accident

On the morning of September 27, 1981, a 12-man crew employed by the Britt Trucking and Construction Company (Britt) was preparing a wellsite and a well access road in a cotton field about 5 miles southwest of Ackerly in Martin County, Texas. The site was being prepared for the Jet Oil Company (Jet). The crew had cleared and leveled the drill site and constructed a caliche 1/ pad for a rotary drilling rig which was scheduled to arrive on the wellsite the following day. The pad would provide the drilling rig with a hard, smooth, level area on which to operate. A cellar 2/ had been excavated by a bulldozer and formed with boarded sides around the spot where the well was to be drilled. At the time, five persons were working at the wellsite, one person was working nearby, and six persons were driving dump trucks which were hauling caliche from a nearby pit to the access road. (Refer to figure 1.)

Also during the morning, a drilling operator and an assistant, employed by C.B. Harris Rathole Service (Harris), arrived at the site with a truck-mounted rathole drilling rig and a pickup truck. Gene Sledge Drilling Corporation (Sledge), the rotary drilling contractor, had contracted Harris to drill three shallow holes at predetermined locations,

1/ Caliche - a surface crust of calcite formed in arid or semi-arid limestone regions. The material is used as a base for unpaved roads.
2/ Cellar - an excavated pit with boarded sides around the well, which provides space for wellhead equipment.

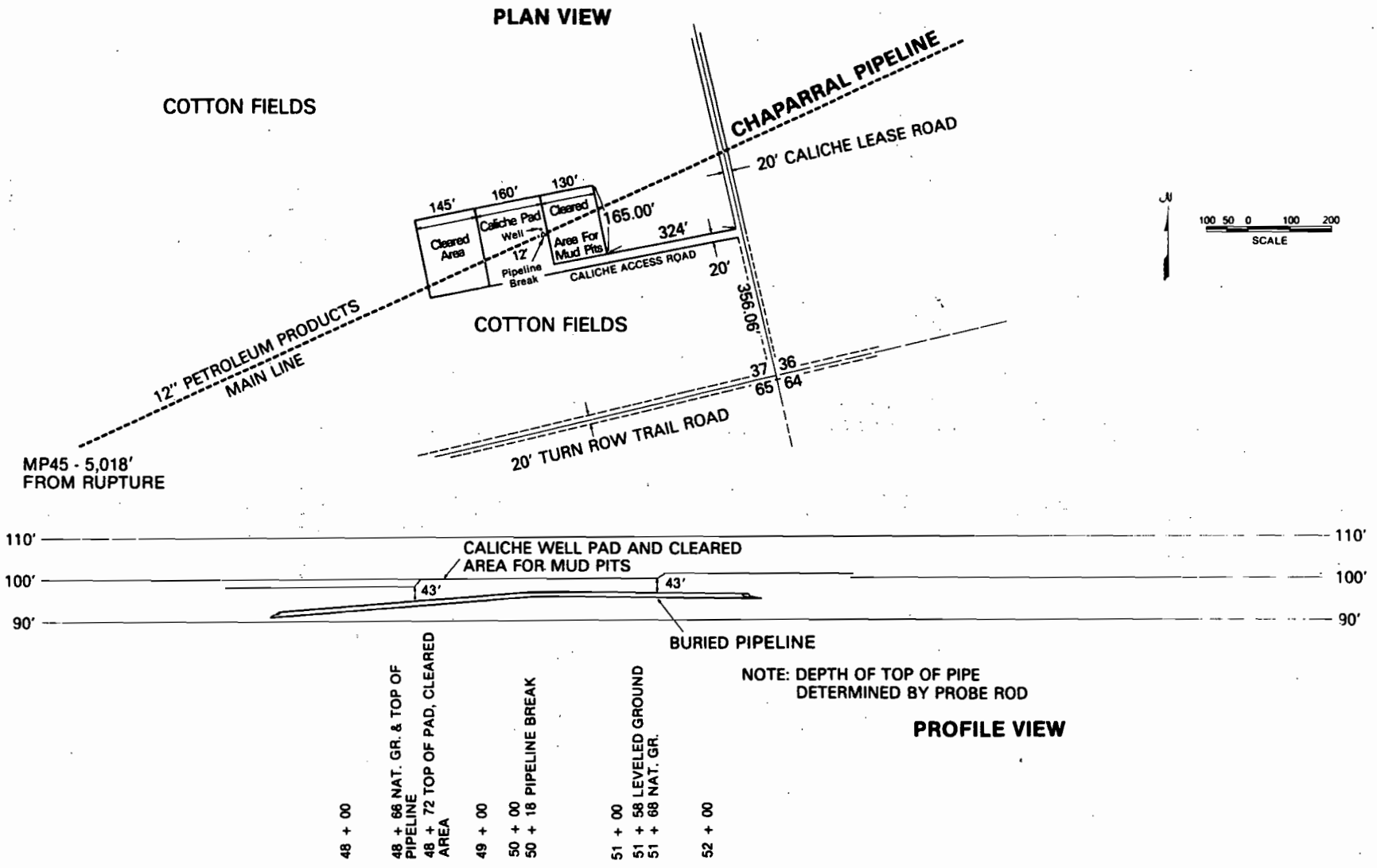



**Figure 1.--Well location site.**

angles, and depths in preparation for the rotary drilling rig. The drilling operator had been employed by Harris for 2 years and had been drilling for about 1 year; the assistant, who was responsible for shoveling drill cuttings away from the holes had been employed by Harris for only a few days.

The operator drilled a 17 1/4-inch diameter surface hole 40 feet deep into the cellar; a 12 1/4-inch diameter mousehole 3/ 18 feet deep, adjacent to the cellar (see figure 2); and then began drilling a 12 1/4-inch diameter rathole 4/ near the corner of the cellar (see figure 3). At the time, the assistant was nearby.

At 1:38 p.m., c.d.t., the rathole bit was drilling on Chaparral Pipeline (Chaparral) 12-inch steel pipeline, which was operating at a pressure of 1,100 psig; it ruptured, and escaping ethane-propane mixture (E-P Mix) was ignited by the engine of the rathole drilling rig. (See figures 4, 5, and 6.)

**Emergency Shutdown Procedures**

At 1:38 p.m., the pipeline dispatcher in Tulsa, Oklahoma, received three alarms (indicating a sudden pressure loss) from Chaparral's unattended Ackerly Station, which was located at milepost (MP) 50, 4 miles downstream from the accident site. At the time, this station was not pumping.

At 1:40 p.m., the dispatcher received confirmation that the pipeline was losing pressure from the manned San Andres Station, located upstream from the accident site at MP 0.0, and from the unmanned Snyder Station, located downstream at MP 95.0. Both stations were pumping at the time of the accident.

The following actions took place to effect emergency shutdown:

| Time | Action |
|---|---|
| 1:41 p.m. | The dispatcher remotely closed the suction valve at Ackerly Station. |
| 1:42 p.m. | After receiving an indication that the suction valve at Ackerly Station had closed (this prevented backflow of product through the station which was otherwise blocked by a check valve in the mainline), the dispatcher sent the weekend, on-call technician at Snyder Station to the Ackerly Station. |
| 1:44 p.m. | The dispatcher remotely lowered the suction set-point at the Snyder Station from 560 to 450 psig (the suction pressure, which had been 595 psig at 1:38 p.m., had decreased to 544 psig) and instructed San Andres Station personnel to shut down all mainline pumps, block the mainline, and divert all laterals to storage wells. |

3/ Mousehole - a shallow angular hole used to store a joint of drill pipe.
4/ Rathole - a shallow angular hole used to store the kelly, which is a square joint of drill pipe that is turned by the rotary table.

Figure 2.--Cellar and 12-inch replacement pipe.

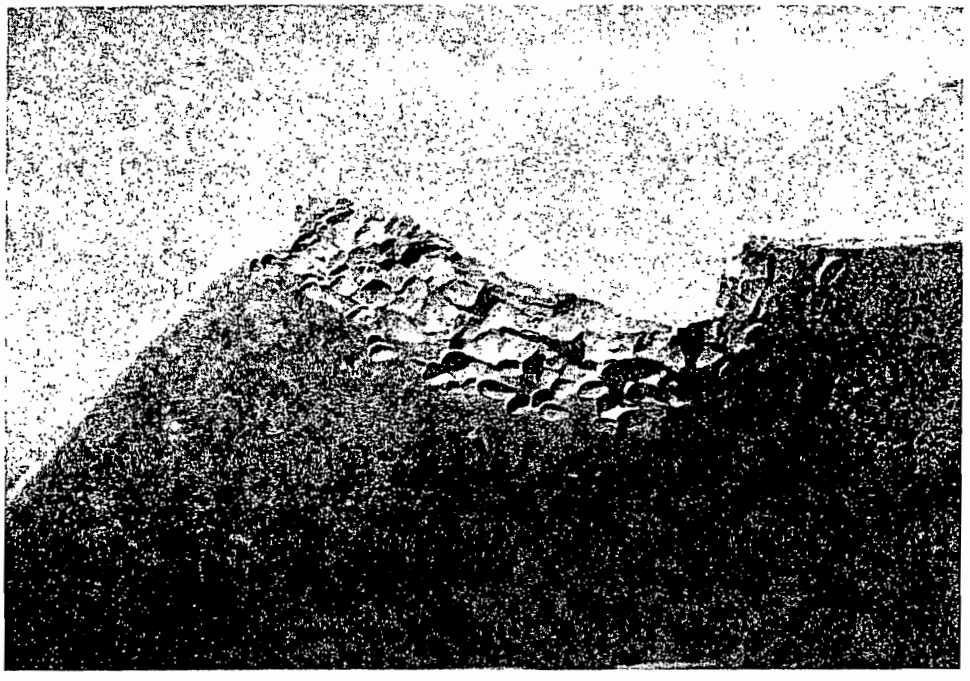
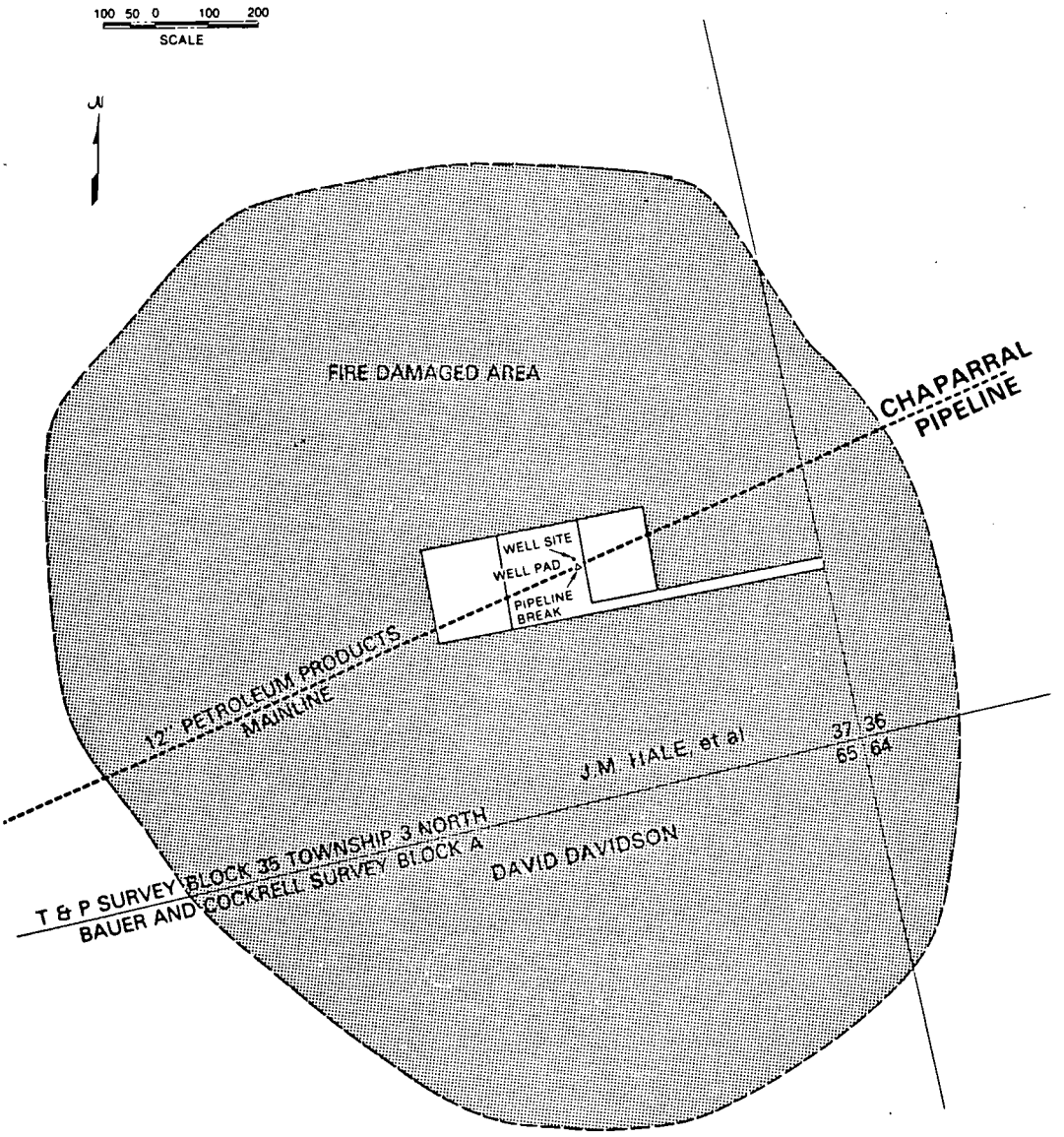


Figure 3.—Drill-bit marks on 12-inch pipe.

Figure 4.--Fire, ruptured pipeline, and rathole drilling rig.




NOTE:

TOTAL DAMAGED AREA DUE TO EXPLOSION AND FIRE

59.46 ACRES

ACREAGE OF WELL SITE AND ACCESS ROAD

2.00 ACRES

Figure 5.--Area damaged by explosion and fire.

Figure 6.--Accident site.

1:47 p.m. The dispatcher received an indication that all mainline pumps at San Andres Station were off.

1:48 p.m. The dispatcher received an indication that the mainline was blocked at San Andres.

1:50 p.m. The dispatcher received a suction pressure alarm which indicated that the suction had decreased to 446 psig at Snyder Station.

1:52 p.m. The dispatcher remotely shut down pump No. 1 at Snyder Station.

1:53 p.m. The dispatcher received an indication that pump No. 1 was off at Snyder station.

1:55 p.m. A drilling consultant, who was working on a rotary rig at a well 4,600 feet south-southwest of the accident site and within 1,200 feet of the pipeline marker at MP 45 (see figure 7), telephoned the dispatcher and reported that the mainline was ruptured and on fire east of MP 45.

2:00 p.m. After receiving an indication that the remaining pump at Snyder Station had shut down because of seal failure (suction pressure had decreased to 431 psig), the dispatcher notified the Chaparral superintendent, the manager of product movement, and the weekend, on-call technician and advised each person of the circumstances.

2:14 p.m. The dispatcher attempted to close the mainline block valve remotely at Ackerly Station, but it would not close. (Several subsequent attempts to close the valve were also unsuccessful.)

2:22 p.m. The dispatcher remotely closed the mainline block valve at Snyder Station.

2:23 p.m. After receiving an indication that the mainline block valve at Snyder Station had closed, the dispatcher remotely closed the downstream stations sequentially until, at 2:55 p.m., the terminal station at Mont Belvieu was closed.

2:45 p.m. The drilling consultant near MP 45 telephoned the dispatcher and requested permission to cut the chain which secured mainline valve No. 4 at MP 45 and close the valve. The dispatcher granted the consultant permission after verifying the valve's identity and the valve was closed.

As a result, 1 hour 7 minutes after the accident, the 5-mile segment containing the break had been isolated by closure of mainline valve No. 4. (The weekend on-call technician and the Snyder Station supervisor arrived at the accident site a few minutes later, and reported that the fire was dying rapidly.)

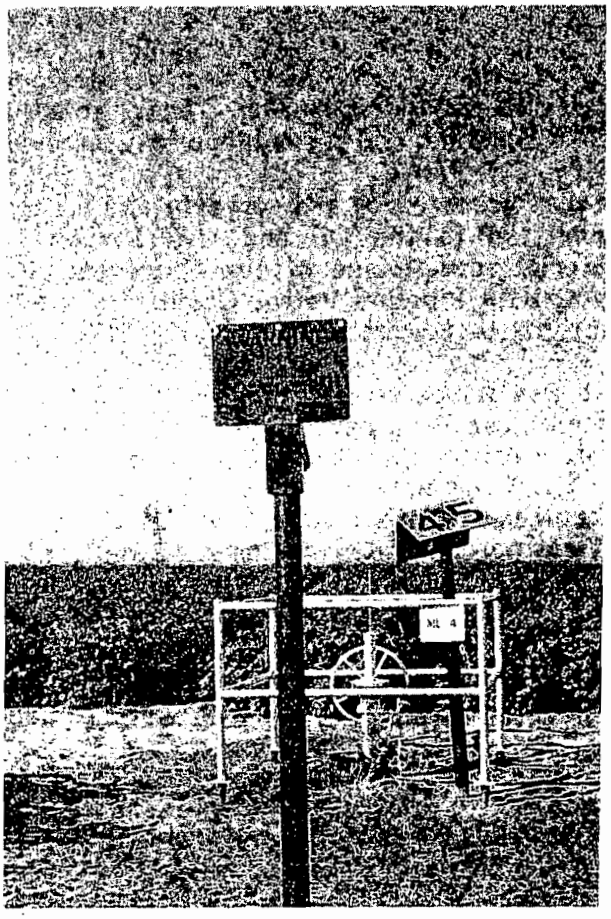


Figure 7.--Pipeline marker, mainline valve No. 4, and aerial marker at MP 45.

At 3:03 p.m., the dispatcher noted that the technician closed the mainline block valve at Ackerly Station, using the valve actuator. 5/

**Events Preceding the Accident**

On October 30, 1978, Jet acquired a 3-year lease from J. M. Hale, et al, on 480 acres which comprised the west half and the southeast quarter of Section 37, Township 3 North, Block 35 - Texas & Pacific Railroad Survey. Jet requested a title search and opinion to assure that a clear title existed on the leased property. The search disclosed that the surface of the land was subject to a right-of-way (ROW) granted to the Reef Corporation covering the entire section. This ROW was utilized to construct a gathering line in the northeast quarter of Section 37. However, the presence of the 12-inch Chaparral pipeline, located in the southeast corner of the section, was not uncovered in the title search.

On August 24, 1981, a registered professional surveyor staked a location for a well, identified as Jet Oil Company Hale "B" No. 1, to be drilled at a spot located 660 feet north and 660 feet west of the southeast corner of Section 37, Township 3 North,

5/ Several postaccident attempts were made later to operate this valve, both remotely from the Tulsa Station and at the station; all of these attempts were successful.

Block 35 - Texas & Pacific Railroad Survey. Knee-high cotton covered most of Section 37 and the adjacent sections. The surveyor was assisted in finding one of the property corners by a friend of the property owner, who was at the location with the property owner. The property owner lived in Big Spring, Texas, about 20 miles away. No one mentioned the presence of a pipeline, and the surveyor saw no evidence of a pipeline.

On August 26, the plat prepared by the surveyor and an application for a permit to drill the well were submitted to the Oil and Gas Division of the Texas Railroad Commission (TRRC). Aerial surveillance of the Chaparral pipeline was conducted on September 15 and 16 by Griffin Pipeline Patrol Company. At that time, there was no evidence of impending activity on the property.

The drilling permit was issued on September 17, 1981. However, Jet decided to move the stake for the well closer to a newly completed producing well. In response to a telephonic request by Jet, a Britt supervisor and a Jet pumper moved the stake 190 feet south and 190 feet east of the original location. Before the final stake was driven, they were joined by a Jet foreman. At that time, none of the men saw any evidence of a pipeline. A tank battery was noted 2 miles northeast of the location, but at that distance, its related flow lines were of no concern to Jet.

Although the change in location was within the tolerance provided by TRRC Spacing Rule 37, Jet was required to submit a revised plat with an application for an amended drilling permit. The permit for the new location was issued on September 21, 1981.

Britt moved onto location on September 21 and began preparation of the wellsite and the caliche access road. Two Britt supervisors, one of whom had staked the location, looked for evidence of a pipeline in the immediate vicinity but found none. Both were experienced in preparing wellsite locations and were former pipeliners. Britt's initial activity of clearing the location and leveling the drill site revealed no trace of a backfilled pipeline trench.

Entry to and exit from the location were along section line roads, which were simply dirt trails from the east, west, and north. The north road was being surfaced with caliche to serve as a well access road; there were no pipeline markers on these roads. (See figure 8.)

**Injuries to Persons**

| Injuries | Operating Personnel | Other | Total |
|---|---|---|---|
| Fatal | 4 | 0 | 4 |
| Nonfatal | 0 | 0 | 0 |
| Total | 4 | 0 | 4 |

The drilling rig operator, who had been positioned almost directly over the rathole, was killed instantly. His assistant was critically injured and as a result of his injuries died 4 days later. Two employees of Britt were also killed.

**Damage to Pipeline**

The pipe wall was weakened by the drilling bit which nearly penetrated it. Internal pressure ruptured the weakened pipe and completely severed the pipe; about 10 feet

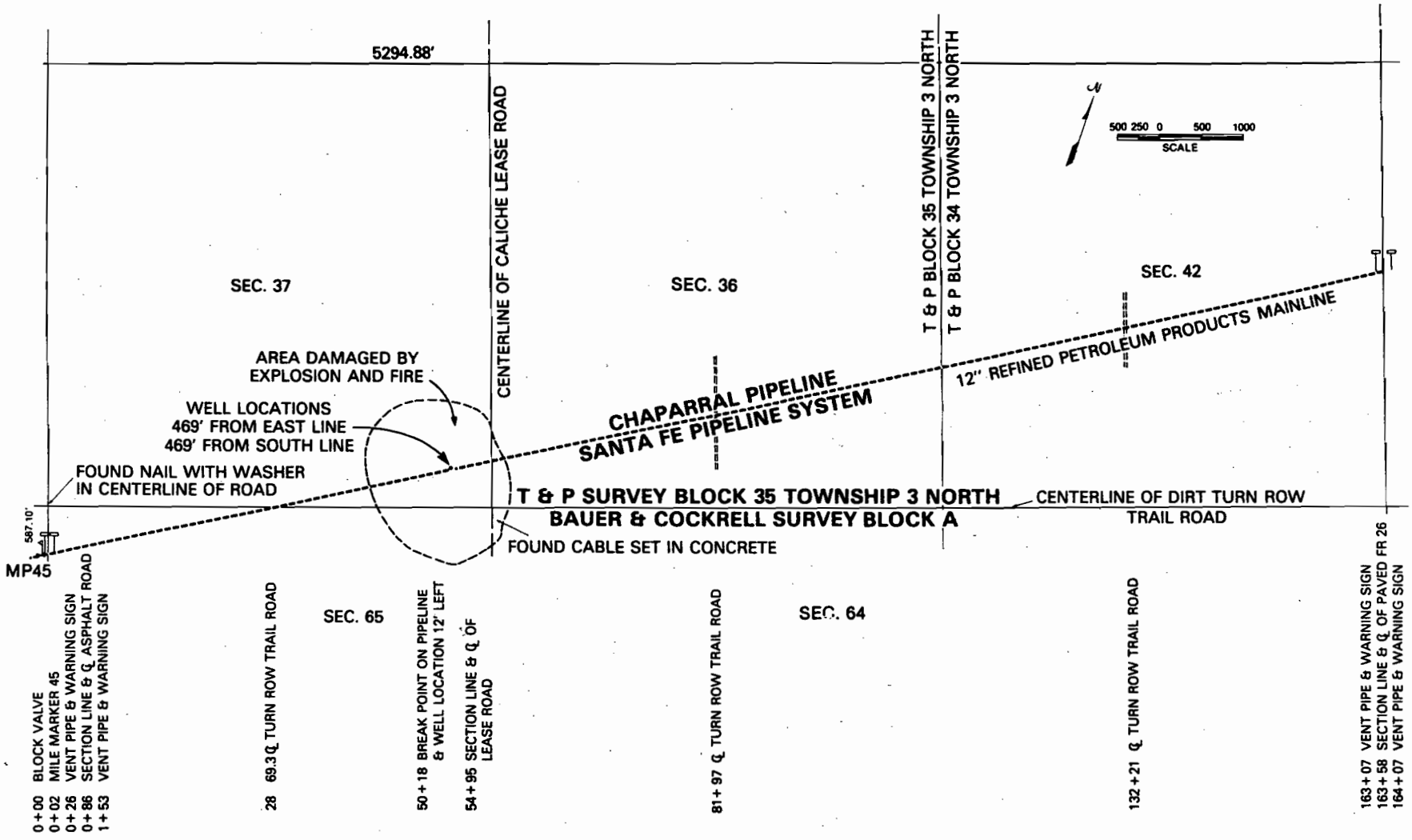



Figure 8.--Overall pipeline location.

of the upstream end whipped back toward the southwest (see figure 3). A longitudinal rupture spiralled and extended downstream for 6 feet.

Chaparral's superintendent assisted in the shutdown operations by phone and coordinated preparations to repair the pipeline so that it could be returned to service. Pretested pipe arrived at the accident site on the morning of September 28, and by 2:00 p.m., 66 feet of pipe had been installed and the welds had been x-rayed. (See figure 6.) Product was then injected at San Andres and the line was pressured up to the valve at MP 45. At 10:15 p.m., the valve was opened to fill the section, which included the rupture, up to the Ackerly Station.

The pipeline was returned to normal operations at 3:45 a.m. on September 29. On September 30, the newly installed pipe was cleaned, primed, and taped; the ditch was backfilled; and the area was cleaned up.

**Other Damage**

The explosion and fire destroyed the rathole drilling rig and a pickup truck. The fire also destroyed a road grader, a compactor, 60 acres of cotton, and burned 12,749 barrels (535,458 gallons) of E-P Mix.

**Pipeline Information**

The Chaparral Pipeline, owned and operated by the Santa Fe Pipeline System as a common carrier, transports natural gas liquids from the West Texas-New Mexico area to Mont Belvieu, Texas. The 12-inch main line, which is 515 miles long, originates at Chaparral's San Andres, Texas, facilities and runs northeasterly to Snyder, Texas, where additional facilities are located, and then runs southeasterly to Mont Belvieu, Texas, where the liquids are delivered to fractionators and storage facilities. A network of gathering lines in the West Texas-New Mexico area collects the liquids from extraction plants, and underground caverns at the San Andres facility are used to store the liquid before shipment in the mainline. Company owned gathering lines and underground storage owned by others are connected to the Snyder facilities.

The Chaparral mainline consists of 12 3/4-inch outside diameter, American Petroleum Institute (API) 5LX-52 pipe with a wall thickness of 0.250 inch. It was installed between 1970 and 1971, at a depth of 36 inches generally and below 43 inches at the accident site, and hydrostatically tested to a maximum pressure of 2,039 psig for 24 hours. The maximum allowable operating pressure (MAOP) for the pipeline and piping components is 1,440 psig. The minimum pressure limit must be higher than the vapor pressure of the natural gas liquid product, which varies in composition, being transported at the flowing temperature.

On July 9, 1971, the Santa Fe Pipeline Company made application to the TRRC for a permit to operate the Chaparral Pipeline in accordance with Rule 36 (now Rule 70), to assure "that the proposed line is, or will be, so laid, equipped, and managed, as to reduce to a minimum the possibility of waste, and will be operated in accordance with the conservation laws and conservation rules and regulations of the Commission." This permit was issued on July 27, 1971.

A supervisory control system monitors pipeline operations and provides information regarding pressure, flow, and other data to the dispatcher in Tulsa. The system also checks for and alerts the dispatcher to rapid changes in and deviation from set point

values. The supervisory signals are carried on leased telephone lines. Additionally, the system monitors the status of pumping units, valve positions, and safety devices installed at the various pipeline facilities.

Each pump station, including those that are manned, is designed to be operated unattended and to automatically shut down if the design limits are reached. Three pressure switches are installed at each pump station to prevent operation of the pipeline outside its designed pressure limit envelope: a "low suction" pressure switch prevents operation of the pipeline below the minimum operating pressure; a "high case" pressure switch protects the station manifold; and a "high discharge" pressure switch prevents operation of the pipeline above its MAOP. The activation of any one of the switches will initiate the shutdown of all pumps at the station and transmit an alarm to the dispatcher.

Each injection facility, most of which are owned by the customer supplying product to Chaparral, is monitored by the supervisory system which supplies the dispatcher information on pressure, temperature, flow rates, density, $H_2S$ concentration, alarm messages, and accumulated product flow readings.

There are 10 pump stations, spaced about 50 miles apart, along the 12-inch Chaparral mainline. These pump stations can be controlled manually, or be controlled remotely by the dispatcher. They will also shut down automatically in the event of a specified pressure loss. Pipeline block valves at injection stations can be opened or closed by use of the supervisory system by the dispatcher. Additionally, the pipeline can be segmented into shorter sections by the use of manually operated block valves which are spaced at varying intervals of up to 21 miles.

The Chaparral Pipeline is patrolled every 2 weeks by Griffin Pipeline Patrol Company (Griffin) in accordance with the requirements of 49 CFR 195.412. (See the appendix.) Aerial surveillance was conducted along the pipeline on September 28 and 29. Photographs taken after the accident revealed traces of the location of the Chaparral pipeline which would not be apparent visually to persons on the ground. (See figure 9.)

The frequency of pipeline surveillance commonly exceeds the required bi-weekly interval. Aerial surveillance is conducted on some pipelines twice a week, depending on the operating pressure, the product carried, and line location. Surveillance patrols are also flown during the hydrostatic pressure test of a pipeline.

Surveillance procedures and schedules can be affected by the weather. The altitude at which the surveillance is conducted may also be affected by the weather, as well as the time of day and the terrain. A "high patrol" may be flown at a height of 1,000 feet and a "low patrol" may be flown at 200 to 300 feet. Sometimes in open country with favorable relief the distance above ground level may be only 100 feet.

**Characteristics of the Ethane-Propane Mixture**

| Component | Formula | Boiling Point °F at 14.696 psig | Flammability Limits Vol. Percent in Air Mixture | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Ethane | $C_2H_6$ | - 127.48 | 2.9 | 13.0 |
| Propane | $C_2H_8$ | - 43.67 | 2.1 | 9.5 |

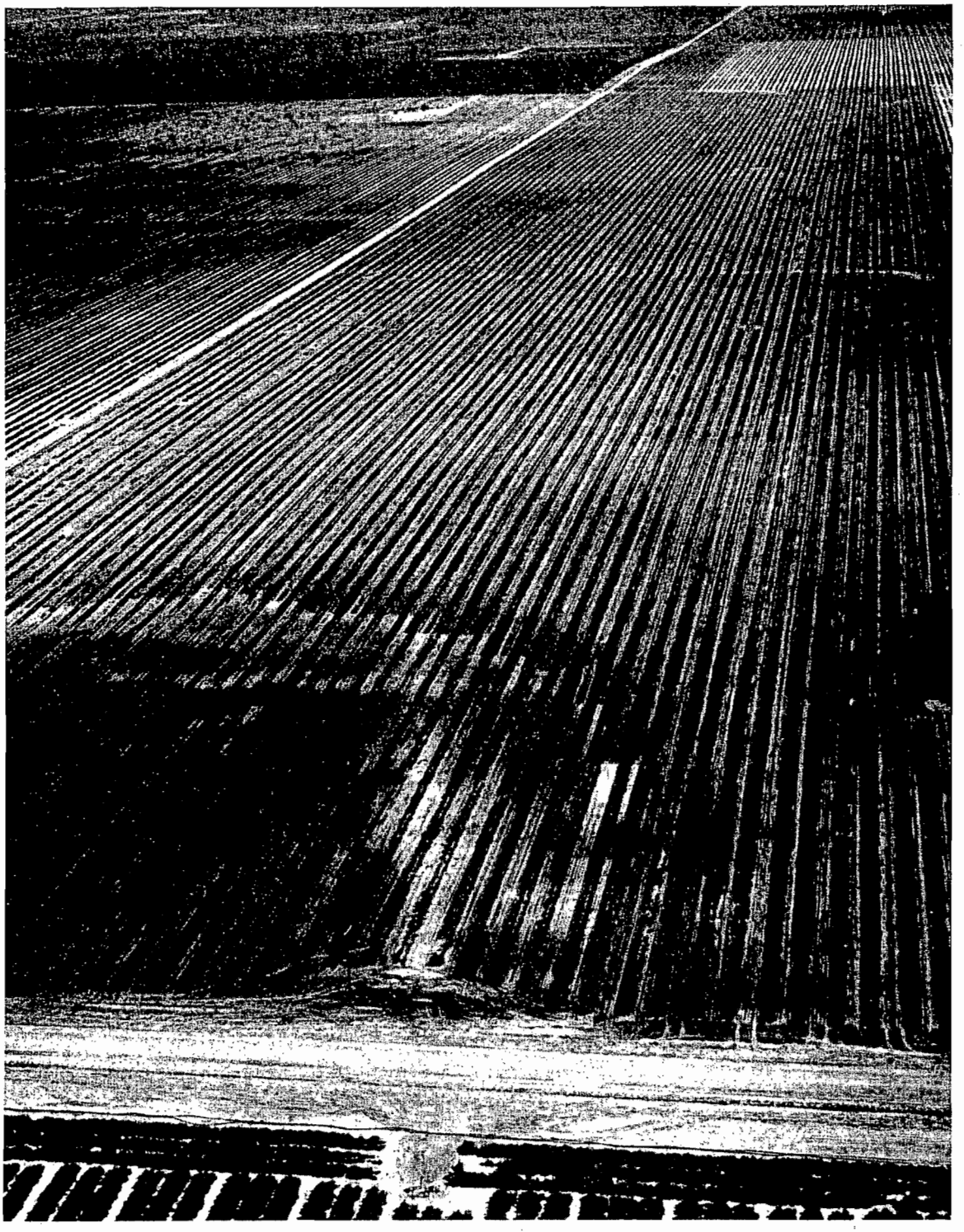


Figure 9.--Downstream view along Chaparral pipeline from MP 45 to accident site.

The specific gravity of the ethane-propane liquid was 0.42 at 60° and 1,000 psig at the accident site.

Ethane is a natural gas, not a liquid, except at very low temperatures. However, the 70-percent ethane, 30-percent propane product in the Chaparral line is liquid at 574 psig and 60° F. When it is released into the atmosphere, it expands at an approximate rate of 277 to 1, refrigerating the air, and causes moisture in the air to freeze and generate a white, foglike vapor. The vapor is heavier than the air and stays near the ground. It is difficult to dispose of the product safely when it is released inadvertently.

## Meteorological Information

At the time of the accident, the visibility was excellent. There was a light westerly wind, and the temperature was in the low 90's.

## Other Information

Rathole Drilling Operation--Drilling of the surface hole, the mousehole, and the rathole in normally dry soil usually take only 4 to 5 hours since the holes are drilled with the use of compressed air and this increases the drilling rate. The rathole and mousehole are drilled with a 12 1/4-inch button bit, which is a tri-cone drill-bit with tungsten carbide buttons, affixed to a short stabilizer on the bottom of a kelly. The kelly is turned by a rotary table through which it feeds as drilling progresses. (See figures 10 and 11.) Compressed air travels through the hollow kelly and out small ports in the drill-bit to bring cuttings back to the surface.

Pipeline Accidents--This is not an isolated incident; there have been other similar pipeline accidents involving drilling activities:

> On September 4, 1981, a drilling rig, operated by a crew core-drilling for coal near Belle, West Virginia, punctured a 12-inch gas transmission line. The transmission line was operated by Columbia Gas Transmission Corporation, and at the time of the accident, was operating at a pressure of 600 psig. The rig operator was injured, the rig and a truck were destroyed, and an estimated volume of 3,433,000 cubic feet of gas was lost.
>
> On October 2, 1981, a rathole rig drilling near Andrews, Texas, ruptured a crude oil gathering line. Sour crude oil escaped from the line. No one was injured.
>
> On May 27, 1980, near Cartwright, Louisiana, an anhydrous ammonia pipeline operated by Santa Fe's Gulf Central Pipeline Company, was struck by a bulldozer which was being used to prepare a wellsite, and the pipeline ruptured. Over 100 people were evacuated from the area. 6/

Drilling Acitivity--Over 500 rotary drilling rigs are currently operating in the Permian Basin of West Texas and New Mexico where 12 percent of the drilling activity in the United States takes place. A majority of the drilling is for development wells that are located in areas densely underlain by pipelines, many of which are unmarked. The surveyor, who staked the Jet wellsite, stated that he had staked and moved another

6/ "Pipeline Accident Report--Summary Format, Issue Number 1--1982" (NTSB-PAR-82-1).

Figure 10.--Rathole rig mast, bent kelly and drill-bit.

Figure 11.—Drill-bit and stabilizer sub.

wellsite for the third time because of pipeline conflicts. The pipeline surveillance reports for the Chaparral right-of-way were also indicative of the extent of drilling activity. The preaccident patrol report noted, "MP 171 Drilling rig with slush pits 50 yards south of ROW," and the postaccident patrol report stated: "MP 4 1/2 Drill pads on north edge of ROW."

The State of Texas has over 200,000 miles of pipelines, of which 110,000 miles are natural gas pipelines, 75,000 miles are oil pipelines, and the remainder are product pipelines. Additionally there are thousands of miles of gathering lines 7/ in the State. The United States has about 1,000,000 miles of natural gas pipelines and 250,000 miles of liquid pipelines. Current cumulative information on "reportable leaks" 8/ reveals that over 16 percent of the equipment-caused ruptures in the United States have occurred in Texas. (See tables I through III.)

Table I.--Liquid Pipelines 1968-81

| | Total Leaks | Equipment Rupturing Line |
|---|---|---|
| U.S. | 4,112 | 1,101 |
| TX | 1,488 | 356 |

Table II.--Gas Distribution Pipelines 1970-81

| | Total Leaks | Damage by Equipment Operated by Outside Party |
|---|---|---|
| U.S. | 11,668 | 4,170 |
| TX | 875 | 408 |

Table III.--Gas Transmission 1970-81

| | Total Leaks | Damage by Equipment Operated by Outside Party |
|---|---|---|
| U.S. | 6,663 | 1,827 |
| TX | 1,264 | 412 |
| U.S. | 22,443 | 7,098 |
| TX | 3,627 | 1,176 |

7/ Leaks and equipment-caused damages involving gathering lines are not reportable to the Department of Transportation (DOT) because 49 CFR 192.1 and 49 CFR 195.1 exempt most gathering lines from code requirements.

8/ DOT 20-day written reports for specified gas pipelines do not include leaks experienced by operators with less than 100,000 customers; DOT 15-day written reports are submitted for specified liquid pipelines.

Location of Pipelines--The operator (oil or gas company) is usually responsible for siting a well at a proper location and for other hazards on a drilling lease either by industry practice, permit requirements in some states (not Texas), or as in this case, by contractual agreement 9/ which stated:

> Responsibility for a Sound Location--Operator shall prepare a sound location, adequate in size and capable of properly supporting the drilling rig, and shall be responsible for a conductor pipe program adequate to prevent soil and subsoil washout. It is recognized that Operator has superior knowledge of the location and access routes to the location, and must advise contractor of any sub-surface conditions, or obstructions (including, but not limited to mines, caverns, sink holes, streams, pipelines, power lines and telephone lines) which Contractors might encounter while en route to the location or during operations hereunder. In the event sub-surface conditions cause a cratering or shifting of the location surface, or if seabed conditions prove unsatisfactory to properly support the rig during marine operations hereunder, and loss or damage to the rig, its associated equipment or personnel results therefrom, Operator shall, without regard to other provisions of this contract, reimburse Contractor to the extent not covered by Contractor's insurance, for all such loss or damage including payment of work stoppage rate during repair and/or demobilization if applicable.

The American Petroleum Institute (API) publishes recommended practices (RP) for operating and drilling companies which are based on industry experience and take into consideration good operating procedures. Two of these RP's, although not addressing the hazards of pipelines beneath drilling locations, contain information regarding the selection of drilling sites and their preparation; these are, RP 52: "Recommended Land Drilling Operating Practices for Protection of the Environment", and RP 54: "Recommended Practices for Occupational Safety and Health for Oil and Gas Well Drilling and Service Operations."

Information regarding the presence of a pipeline may appear in land records as a right-of-way encumbrance, on various maps, such as the U.S. Geological Survey's topographic maps and the API liquid pipeline maps which are revised annually. In some instances, it can be obtained from the property owner. The location may be marked at its intersections with roads in accordance with the requirements of 49 CFR 195.410 (see appendix) or it may appear as a trace on the ground. The location can be determined by use of a pipe locator or metal detector. The most effective means to establish the presence and location of a pipeline is to have the operating company mark the pipeline.

Permit Requirements--The TRRC's Oil and Gas Division requires that an application for a permit to drill a well be made under the provisions of its Rule 37, or an exception thereto, "in order to prevent waste or to prevent the confiscation of property." The rule provides for a standard spacing pattern of one well to each 40 acres, and allows a limited deviation from this spacing. The rule also specifies that the permit application be accompanied by a plat, or a sketch drawn to scale, showing the property, the well location, and the location of any existing wells. There are no requirements that the survey plat show the location of any hazard within a prescribed distance of the drilling location.

9/ International Association of Drilling Contractors (IADC) U.S. Footage Contract Standard Form, revised September, 1979.

Pipeline Markers--The Chaparral pipeline was marked at its intersections with the nearest public roads in accordance with the requirements of 49 CFR 195.410. The nearest markers for this northeastwardly trending section of pipeline were located along the north-south roads on both sides of the accident site, about 1 mile southwest at Farm Market Road (FM) 3263, and 2 miles northeast at FM 26. (See figure 7.)

Entry to the drill site along the section-line roads from the east, or north - the latter of which was surfaced with caliche to serve as well access road - could be made without passing by either pipeline marker. Entry along the section-line road from the west would have originated near the pipeline marker and mainline valve No. 4. The relative condition of this road was not favorable for use as an access to the drillsite.

## ANALYSIS

### Wellsite

The process of establishing the location of the well provided several opportunities for determining the existence and location of any conflicting pipelines. When the title search was made to assure that a clear title existed on the leased property, the search should have revealed that the Chaparral pipeline ROW existed as an encumbrance. The existence of the pipeline was documented on various maps used by the petroleum industry. The property owner, who was aware of the pipeline's existence, was not queried by anyone.

The pipeline company could have provided the location of the pipeline in response to a direct request, but none was made. (A "one-call" system by which notification of planned drilling could have been made does not exist in West Texas). A surveyor is normally the most suitable person to perform the task of detecting the presence of a pipeline; in this instance he was not requested to do so. If the TRRC had required that the survey plat accompanying the drilling permit application show hazards, including pipelines, a more thorough search probably would have been made to determine their presence. The pipeline markers, which were about 1 mile southwest and 2 miles northeast of the well's location, were possibly bypassed or overlooked while interested parties went to and from the well site. Markers could have been sought out on paved roads so that if the alignment of markers appeared critical, the pipeline operator - whose name and phone number appear on the markers - could have been contacted for a precise location. The surface trace of the pipeline in this instance was visible only from the air because of an obscuring cotton crop. Also, in some instances evidence of soil change associated with backfilled pipeline trenches normally would be revealed by grading operations, but in this instance, it was erased by 10 years of deep cultivation.

### Wellsite Preparation

A drilling location which is in conflict with a pipeline presents a hazard beyond that involved in the drilling operation. In this instance, the wellsite and access road covered a 2-acre area, and the 20-foot caliche lease road crossed the 12-inch pipeline. Grading of the road and cut-and-fill operations at the wellsite could have affected the pipeline which had little cover. Although the road and cut-and-fill operations did not affect the pipeline, the bulldozer excavating the cellar cut deeply enough to have contacted the pipeline.

If the rotary drilling rig had been standing by on location, awaiting completion of the shallow drilling by the rathole rig, additional persons would have been present and the number of casualties could have been much greater. Even if the rathole rig's

drilling bit had not contacted the pipeline, the weight of the rotary drilling rig may have crushed the pipeline and led to an increase in the number of casualties.

AIP's recommended practices, RP 52 and RP 54, provide comprehensive procedures relative to the selection and preparation of drilling sites; however, they do not include consideration of detecting the presence of pipelines in conflict with well locations. If these RP's were amended accordingly, they would alert operators to the hazards of pipelines and offer guidance in determining their location before commencing any activities on the drilling site.

**Pipeline Surveillance**

Aerial surveillance is the method which best detects the evidence of third-party activity encroaching upon a pipeline ROW. However, the effectiveness of surveillance depends upon its frequency. If the aerial patrol of this section of the Chaparral pipeline had been flown weekly, rather than biweekly, the activity over the pipeline would have been observed. The pipeline operator would have been notified, the pipeline location could have been staked, and the well location could have been moved accordingly.

The increased value of hydrocarbons has spurred drilling activity and increased the potential for pipeline accidents resulting from this activity. A reevaluation of the cost-effectiveness of more frequent aerial patrols in the light of this increased drilling activity would appear to be indicated.

**"One-Call" System**

A statewide, one-call notification system for providing advance notification to the operators of underground facilities about proposed excavations does not exist in Texas. If a "one-call" notification system had been in effect, its use could have prevented this accident. The increased drilling activity, particularly that for development purposes in the Permian Basin, has increased the likelihood of drilling-related pipeline accidents.

In a special study on safe service life for petroleum pipelines, 10/ the Safety Board found that most pipeline carriers regard ruptures of their pipeline by outside excavation equipment used in construction as their biggest current problem. Pipeline ruptures caused the most accidents in 1974 and 1976, the loss of liquid product from pipelines, and the most casualties. A survey 11/ of "one-call" systems conducted in 1977 claims a markedly downward trend in measured damage in the areas covered by 88 percent of the systems contacted.

According to the special study, between 1968 and 1976, Texas led all other states with 203 equipment-caused ruptures on its more than 35,000 miles of liquid pipelines. During the same period, Oklahoma, the state with the next highest number of accidents, had 88 ruptures reported in its 8,638 miles of pipeline. In 1976, the only "one-call" system operating in Texas or Oklahoma was in the City of Houston, Texas. As a result of its special study, the Safety Board recommended that the Governors of the States of Oklahoma and Texas:

> Take action to develop and implement statewide "one-call" excavation notification systems. (Class II, Priority Action) (P-78-65)

10/ Special Study, "Safe Service Life for Petroleum Pipelines (NTSB-PSS-78-1).
11/ Interstate Commerce Commission, Annual Part 6 Pipeline Reports, 1968-1975.

Response from the Office of the Governor of the State of Texas expressed support for the intent of a "one-call" notification program. Following an exchange of correspondence between the Safety Board and the Governor's Office, a letter was received from the Governor which stated that the Railroad Commission of Texas, the state agency with jurisdiction in the matter, would apprise the Board of the status of plans for such a program. This information has not been received; therefore the Safety Board is reiterating the recommendation.

Subsequently, the State of Oklahoma instituted a "one-call" system. Currently, there is a voluntary effort by the pipeline industry to develop and implement a one-call notification system in the State of Texas. Approximately 25 companies involved in this effort are also members of the "CALL OKIE" system, which now has 75 members and covers most of the major gathering systems as well as the transmission and distribution systems in the State of Oklahoma.

The effectiveness of the "one-call" system has been proven. Current efforts by the pipeline industry to formulate and implement a "system in the State of Texas should be supported by everyone who may be affected and interested. The TRRC should be an active participant in support of the industry's efforts.

**Pipeline Shutdown**

The Chaparral pipeline's supervisory information and control system provided a nearly instantaneous alarm to the dispatcher in Tulsa from the Ackerly Station located 4 miles downstream of the accident site, and then information confirming a line break from the San Andres Station located 46 miles upstream of the accident site. This information allowed shutdown of the mainline at the downstream station within 4 minutes after the accident, and shutdown of the upstream facilities within 10 minutes. A 50-mile segment of pipeline was isolated in a timely manner; however, to further segment the pipeline and confine the rupture to a 5-mile interval, it was necessary to utilize manually operated mainline valve No. 4. Although this valve was closed 1 hour and 7 minutes after the accident, and thereby minimized product loss, 12,749 barrels of E-P Mix nevertheless escaped.

Since only the pump stations, which are located about 50 miles apart, can be controlled by use of the supervisory system, the additional capability to limit product loss in the event of a line break is based upon the relative location of the break, the spacing of the manual valves, and the time required to close them. In consideration of the current value of hydrocarbons (a value of $133,864.50 was given for Chaparral's product loss), it may prove to be cost-effective to install motor operators on the manual mainline valves, where feasible, and automate their operation. The economics at the time of installation of new pipelines would favor closer spacing of sectionalizing valves and their automation.

In this accident, the damage from the explosion and fire occurred within moments of the rupture. Valve closure, no matter how rapid, would not have mitigated the accident. However, it would have saved several thousand barrels of E-P mix.

## CONCLUSIONS

**Findings**

1. The 12-inch product pipeline was damaged and weakened by a rathole drill, and it ruptured under a pressure of 1,100 psig.

2. Jet Oil Company failed to determine the location of the pipeline before drilling operations began.

3. Location of the pipeline could have been determined and the accident could have been prevented if the presence of the pipeline right-of-way had been uncovered during the title search; the Texas Railroad Commission had required that the location of the hazards be included on the survey plat submitted with the drilling permit application; the services of the well-qualified surveyor had been fully utilized; the pipeline operator had been notified of the proposed excavation by direct contact with the operator; or the scheduled pipeline surveillance had been more frequent.

4. The existence of a "one-call" system would have facilitated contact with the operator and might have led to action which would have prevented the accident.

5. There has been an increase of pipeline accidents involving drilling operations, particularly in the Permian Basin, where over 500 rigs are operating; most of the drilling operations are in areas densely underlain by pipelines.

6. Texas leads the nation annually in miles of pipeline and number of equipment-caused pipeline accidents.

7. The pipeline industry is currently in the process of formulating and implementing a "one-call" system in the State of Texas, and these efforts merit the support of the entire petroleum industry and the TRRC.

8. The Chaparral's supervisory information and control system provided for an immediate alarm when the line break occurred and made a rapid shutdown possible, but had no effect in reducing the number of fatalities because near-instantaneous ignition resulted.

9. The capability of segmenting the Chaparral pipeline and limiting the amount of product loss in the event of a line break was affected by the spacing of the manually operated sectionalizing valves and the time required to close them.

**Probable Cause**

The National Transportation Safety Board determines that the probable cause of the accident involving the rupture of a 12-inch products pipeline, which was damaged when struck by a rathole drill, was the failure of the oil company to determine the existence of the pipeline before drilling operations began.

## RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

--to the Santa Fe Pipeline Company:

Support the pipeline industry's efforts to formulate and implement a "one-call" notification system in the State of Texas. (Class II, Priority Action) (P-82-17)

--to the Jet Oil Company:

Establish a procedure to assure that the location of any pipelines potentially in conflict with a drilling location be determined before initiating any activities which may affect the existing grade. (Class II, Priority Action) (P-82-18)

--to the American Gas Association and the Interstate Natural Gas Association of America:

Urge member companies to participate in the current effort to establish a "one-call" notification system in the State of Texas. (Class II, Priority Action) (P-82-19)

--to the American Congress on Surveying and Mapping and the National Society of Professional Surveyors:

Advise members of the circumstances of this accident and urge them to include in the service of staking drilling locations the location of pipelines which may be affected by the drilling operation. (Class II, Priority Action) (P-82-20)

--to the Independent Petroleum Association of America:

Advise member exploration and production companies of the circumstances of this accident and urge them to adopt procedures for determining the location of any pipelines which may be in conflict with their drilling activities. (Class II, Priority Action) (P-82-21)

--to the Railroad Commission of Texas:

Revise its Oil and Gas Division's Rule 37, to require that survey plats also include the location of any hazards within a prescribed distance of a drilling location. (Class II, Priority Action) (P-82-22)

Support the pipeline industry's efforts to formulate and implement a "one-call" notification system in the State of Texas. (Class II, Priority Action) (P-82-23)

--to the American Petroleum Institute:

Advise member exploration and production companies of the circumstances of this accident and urge them to adopt procedures for determining the location of any pipelines which may be in conflict with their drilling activities. (Class II, Priority Action) (P-82-24)

Urge member companies to participate in the current effort to establish a "one-call" notification system in the State of Texas. (Class II, Priority Action) (P-82-25)

Amend the model form drilling contract and ancillary documents to require that the location of any pipeline which potentially may be in conflict with the drilling location and access roads be identified. (Class II, Priority Action) (P-82-26)

Amend Recommended Practices No. 52, "Recommended Land Drilling Operating Practices for Protection of the Environment" and No. 54, "Recommended Practices for Occupational Safety and Health for Oil and Gas Well Drilling and Service Operations" to include consideration for the location of pipelines in staking a drilling site. (Class II, Priority Action) (P-82-27)

**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G. H. PATRICK BURSLEY
Member

April 20, 1982

## APPENDIX

## FEDERAL REGULATIONS FOR THE TRANSPORTATION OF LIQUID BY PIPELINE

§195.410 Line Markers.

(a) Except as provided in paragraphs (b) and (c) of this section, each carrier shall place and maintain line markers over each buried line in accordance with the following:

(1) Markers must be located at each public road crossing, at each railroad crossing and in sufficient number along the remainder of each buried line so that its location is accurately known.

(2) The marker must state at least the following: "Warning" followed by the words "Petroleum (or the name of the commodity transported) Pipeline" (in lettering at least 1 inch high with an approximate stroke of one-quarter inch on a background of sharply contrasting color); the name of the carrier and a telephone number (including area code) where the carrier can be reached at all times. Markers at navigable waterway crossings must also contain the words "Do Not Anchor or Dredge" with lettering not less than 12 inches high with an approximate stroke of 1 3/4 inches on a background of sharply contrasting color.

(b) Line markers are not required in heavily developed urban areas such as downtown business centers where -

(1) The placement of markers is impracticable and would not serve the purpose of which markers are intended; and

(2) The local government maintains current substructure records

(c) Line markers that have been installed before April 1, 1970, may be used until April 1, 1975.

(d) Each carrier shall provide line marking at locations where the line is above ground in areas that are accessible to the public.

§195.112 Inspection of rights-of-way and crossing under navigable waters.

(a) Each carrier shall, at intervals not exceeding 2 weeks, inspect the surface conditions on or adjacent to each pipeline right-of-way.

(b) Except for offshore pipelines, each carrier shall, at intervals not exceeding 5 years, inspect each crossing under a navigable waterway to determine the condition of the crossing.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1982 361-828/314