

NATIONAL TRANSPORTATION SAFETY BOARD

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PIPELINE ACCIDENT REPORT

LONE STAR GAS COMPANY
NORTH RICHLAND HILLS, TEXAS
OCTOBER 4, 1971



NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-PAR-72-3

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16. Abstract At about 4:45 a.m., on October 4, 1971, a small explosion and intense fire completely destroyed a house at 8300 Jerrie Jo Drive in North Richland Hills, Texas. This accident caused the deaths of a father and his two sons and the severe burning of their mother. Almost 3 hours later, the neighboring house at 8304 Jerrie Jo experienced an explosion and fire in the garage which caused the death of the woman occupant and extensive damage to the garage. The National Transportation Safety Board determines that the probable cause of the explosions and fires was the ignition of an accumulation of natural gas which had leaked from a broken service-line connection with a 6-inch gas main and had migrated up and under the concrete slabs of both houses. The length of time taken by gas company personnel to find the leak and their failure to close the three valves on the gas main to isolate the affected area contributed to the second explosion and fire. The delay in the decision to evacuate the houses until after the second explosion and fire was caused by lack of liaison and cooperation between the gas company and the fire department.			
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Appendix A: Soil and Plant Life at
the Accident Site

FOREWORD

The accident described in this report has been defined as a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations.

This report is based on facts obtained from an investigation conducted by the Safety Board. Cooperation during this investigation was received from the Office of Pipeline Safety, the Lone Star Gas Company, the Railroad Commission of the State of Texas, and the North Richland Hills Fire Department.

The conclusions, the determination of probable cause, and the recommendations herein are those of the Safety Board.

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20591
PIPELINE ACCIDENT REPORT**

Adopted: November 8, 1972

**LONE STAR GAS COMPANY, NORTH RICHLAND HILLS,
TEXAS, OCTOBER 4, 1971**

I. SYNOPSIS

At approximately 4:45 a.m., Monday, October 4, 1971, an explosion and fire occurred in a single-family residence in North Richland Hills, Texas. The local fire department arrived at 5:04 a.m., and at 6:21 a.m., the fire was extinguished.

Shortly before 6:00 a.m., personnel from the local gas company arrived and began to search for a gas leak. At 7:39 a.m., another explosion and fire occurred in the attached garage of the single-family residence next door while the firemen were still on the scene and the gas company personnel were still probing for the leak.

After this second explosion and fire, police and firemen evacuated the residents within a four-block radius. Gas company personnel turned off the valves at the gas meters of the houses in the immediate area and removed the meters. At about 8:30 a.m., the major leak, at the junction of the gas main and service line, was located and repaired.

As the result of this dual accident, four persons died, one was burned severely, one house was destroyed and another was badly damaged.

The National Transportation Safety Board determines that the probable cause of the explosions and fires was the ignition of an

accumulation of natural gas which had leaked from a broken service-line connection with a 6-inch gas main and had migrated up and under the concrete slabs of both houses.

The length of time taken by gas company personnel to find the leak and their failure to close the three valves on the gas main to isolate the affected area contributed to the second explosion and fire.

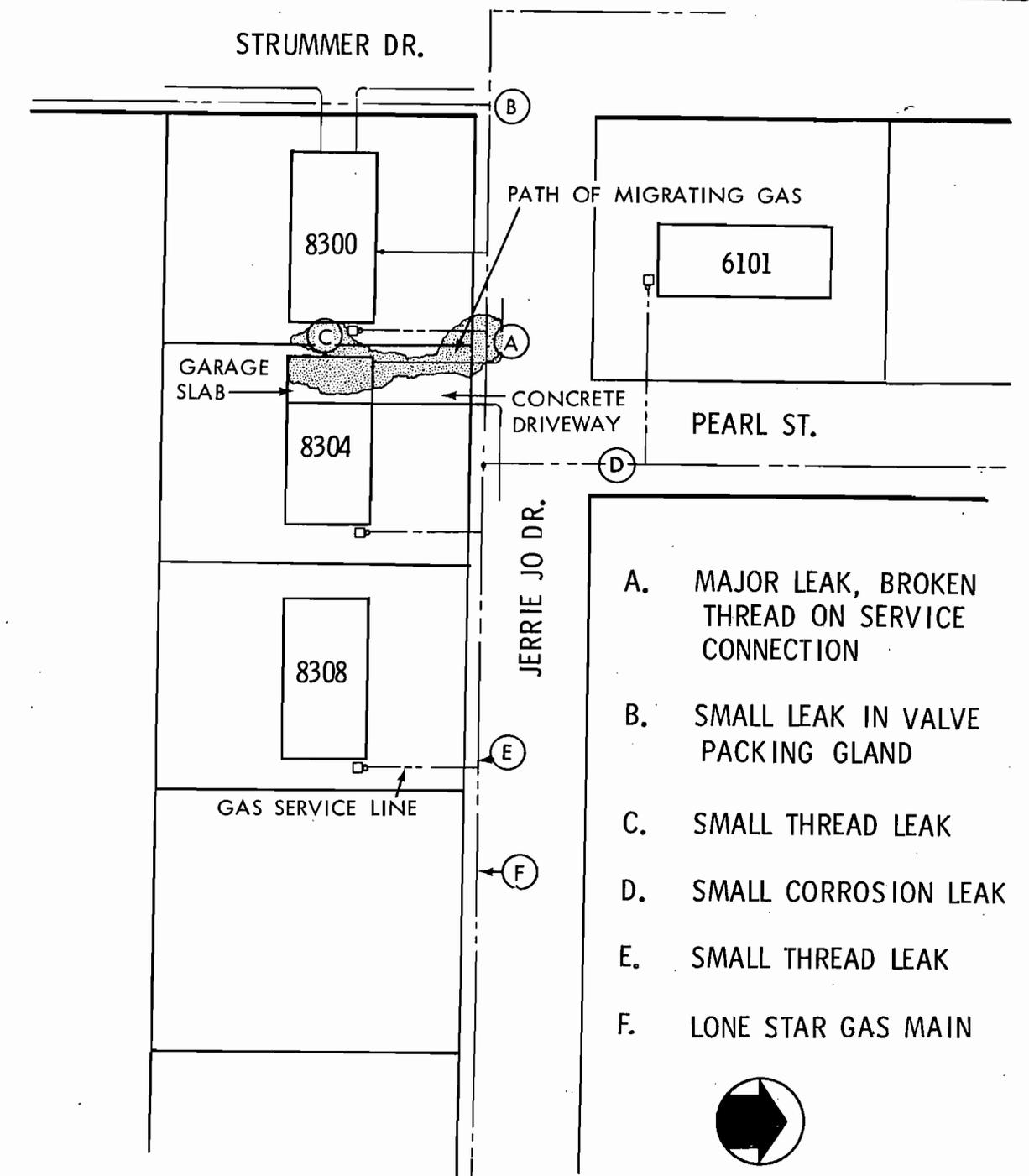
The delay in the decision to evacuate the houses until after the second explosion and fire was caused by lack of liaison and cooperation between the gas company and the fire department.

II. FACTS

Accident Site

This accident occurred in a subdivision of the city of North Richland Hills, Texas, approximately 12 miles northeast of Fort Worth. The houses within this subdivision, which was started in 1956, are brick-veneer, single-family residences built on concrete slabs poured over crushed-stone bases. Each house is located on a 100- by 125-foot lot. The area is served by underground sewer and water lines and by a combination 6- and 4-inch, welded-steel gas main.

Figure 1
**PLOT PLAN OF ACCIDENT SITE AT
 8300 AND 8304 JERRIE JO DRIVE**



The two houses directly involved in the accident were located 20 feet apart, side by side, at 8300 and 8304 Jerrie Jo Drive, about 40 feet south of the gas main. The concrete driveway of the house at 8304 was parallel to and 10 feet east of the gas service line which supplied the house at 8300. (See Figure 1.)

The soil throughout much of the area is a heavy, dark clay which swells and becomes quite adhesive when wet, but which cracks and shrinks when dry. In its saturated state, this soil is not very porous and tends to trap gas, air, and water, allowing them to migrate slowly. When dry, however, the soil develops fissures which permit the rapid passage of these substances.¹

Because a pattern of alternating rainy and dry periods is characteristic of this region, the swelling and shrinking of the type of soil found at the accident site is a normal phenomenon. The swelling and shrinking exerts pressure on any object, such as a gas main or service line, embedded in the soil.

The dirt a few feet east of the gas main-service line connection at 8300 Jerrie Jo Drive and under the driveway at 8304 contained some gravel and was therefore even more porous than the surrounding soil.

Gas Distribution System

A 6-inch, welded-steel gas main, operated by the Lone Star Gas Company, lies 42 inches south of the curblineline of Jerrie Jo Drive. This gas main, which is coated, wrapped, and cathodically protected, extends from west to east and is buried 48 inches deep. Almost halfway across the front lawn at 8304 Jerrie Jo, the diameter of the main is reduced to 4 inches. The main then continues to the east and

¹Appendix A presents observations made by Dr. John S. Chapin, agronomist, concerning the condition of the grass shrubs, and soil at the accident site.

branches to the north to serve the rest of the development. (See Figure 2.)

Valves designed to shut off the flow of gas are located at strategic points along the gas main. Three such valves had been installed at the intersections of Strummer and Jerrie Jo Drives, Jerrie Jo and Pearl Drives, and Pearl Drive and State Highway 121. Closure of these three valves would have shut off the gas flow to the two houses involved in the accident as well as to 35 to 40 other houses in the neighborhood.

Each house in the subdivision is connected to the gas main by means of a 1-1/4-inch galvanized-steel service line. Each service line is attached to the main by short threaded pipe nipples, a plug valve, and two 90-degree elbows, all of which allow the pipe both horizontal and vertical freedom of movement. (See Figure 3.)

The gas main and service lines are operated at 20 to 25 p.s.i.g. up to the individual house meter. At that point, a service regulator reduces the pressure to about 0.25 p.s.i.g.

A shutoff valve is located along with the meter and service regulator at the side of each house.

Characteristics of Natural Gas

Natural gas consists mainly of methane with smaller amounts of ethane and propane hydrocarbons. Lighter than air, natural gas has no odor in its untreated state. However, when distributed through a piping system, the gas must be odorized by the addition of mercaptans.

Natural gas is nontoxic and has no demonstrable effect on human beings in concentrations as high as 25 percent. Deaths which result from the inhalation of a natural gas are caused by asphyxiation. Similarly, natural gas itself is not detrimental to plant life. Large amounts of escaping gas, however,

Figure 2
VALVES ON GAS MAIN IN THE ACCIDENT AREA

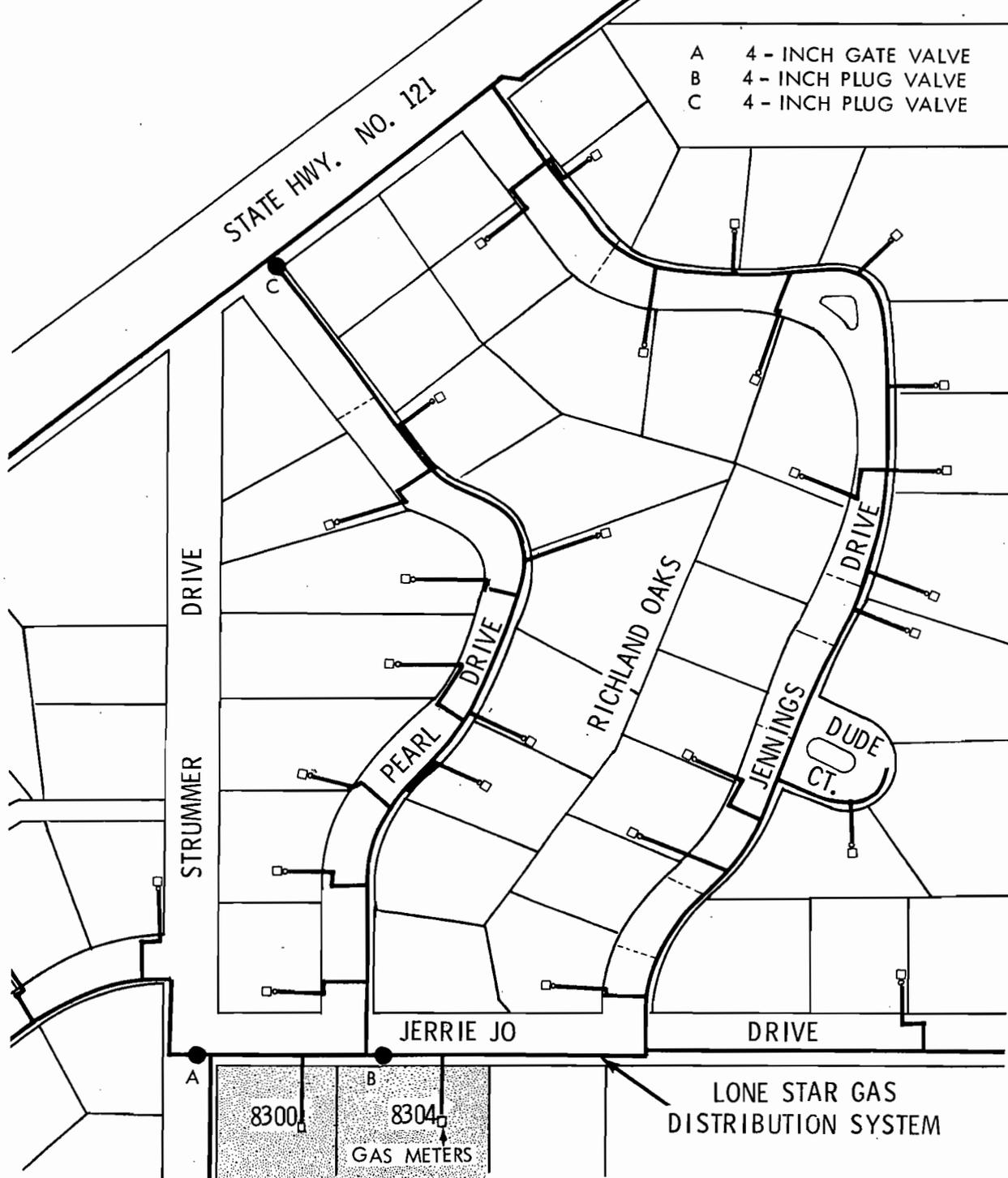
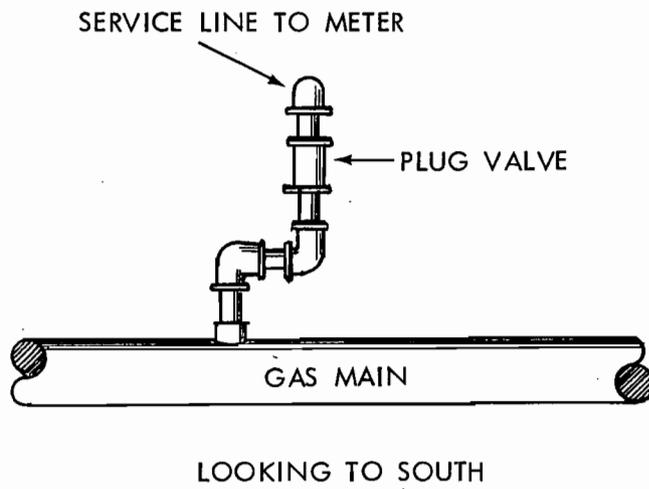
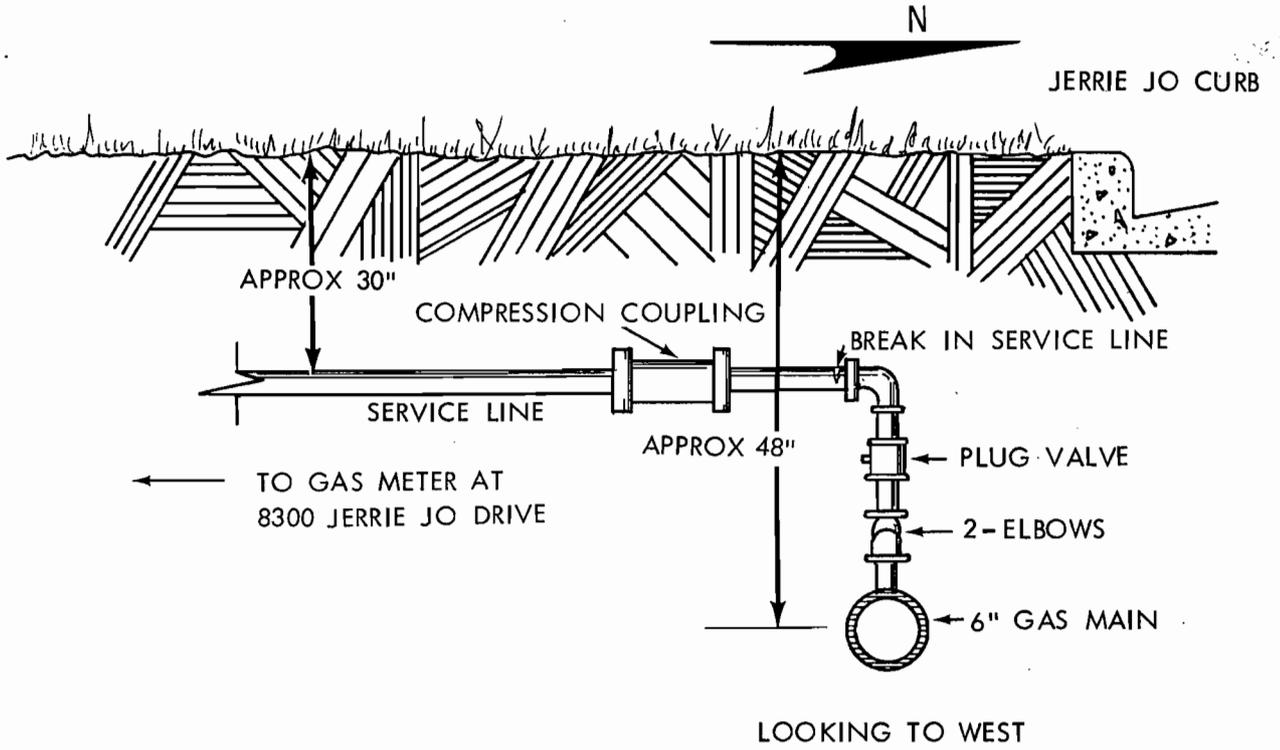


Figure 3
**GAS MAIN – SERVICE LINE
CONNECTION DIAGRAM**



or small amounts escaping over a longer period of time cause soil dehydration, which, in turn, ultimately destroys any affected plants.

The Accident

Heavy rains fell on North Richland Hills all day Sunday, October 3, 1971. National Weather Service records for the Greater Southwest International Airport, 9.5 miles east of the accident site, indicate that precipitation accumulated as follows:

Saturday, October 2—a trace of rain fell between 1 and 5 p.m., but there was no recordable amount.

Sunday, October 3—2.05 inches of rain fell in the 14-hour period extending from 5 a.m. through 7 p.m.

Monday, October 4—0.10 inches of rain fell.

All 3 days were cloudy and overcast.

Rainfall in this area during the month of September 1971 amounted to 3.24 inches, 0.69 inches more than normal.

A daughter and son-in-law had been visiting the family at 8300 on the evening before the explosion and fire. This couple left at about 10 p.m. Up to that time, about 6½ hours prior to the accident, no one detected gas odors and no one mentioned having smelled gas recently.

According to Lone Star's records, up to the time of the accident, there was no indication of a leak problem at either 8300 or 8304 Jerrie Jo Drive. On September 13, a routine service call was made to 8304 Jerrie Jo Drive for appliance adjustment.

Explosion and fire at 8300 Jerrie Jo Drive. At approximately 4:45 a.m. on Monday, October 4, the woman resident at 8300 Jerrie Jo Drive was awakened by heat and heavy

smoke in her bedroom. Her husband entered the room, pulled her out of bed, and then ran with her into the backyard. As they reached the back patio, her husband went back into the blazing house to rescue their two small children.

At this time, the resident at 8304 Jerrie Jo Drive, who had just awakened, heard a loud clap resembling thunder and then heard his dogs begin to bark. He saw his neighbor standing by her fence in her backyard and heard her scream, "We're on fire." Flames were coming out of the rear entrance of her house and rolling out over the back patio. The man ran outside and saw his neighbor at the window of the northeast bedroom trying to reach her 18-month-old son. A couple from across the street dragged a trash can under the window, lifted the baby out of his crib, and took both the baby and his mother to the hospital, where the baby died. The husband and the other child, a 2½-year-old boy, were still inside the intensely burning house. Further attempts to rescue them were impossible.

The North Richland Hills Fire Department arrived at 5:04 a.m. and attempted to enter the house through the rear patio doors as well as through the front entrance. Driven back by intense heat and flames, the firemen shut off the gas supply at the meter on the east side of the house, but this action had no noticeable effect on either the intensity or the duration of the fire. As they battled the blaze, the firefighters noticed that the flames rolled back toward them as though being fed by some type of fuel. They also noticed blue flames coming from underneath the concrete foundation slab at the southeastern corner of the house. Due to the intensity of the fire, additional equipment was ordered to the scene at 5:09 a.m., and at 5:12 a.m. the medical examiner was called. As the flames subsided and the firemen were able to enter part of the house, the bodies of the father and son were

found huddled in the northeast corner of the living room; the medical examiner pronounced them dead at the scene.

At 6:21 a.m. the fire was extinguished and the fire analysis and damage evaluation began.

The Lone Star Gas Company was first notified of the fire at 8300 Jerrie Jo Drive at about 5:35 a.m., and their personnel arrived at the scene about 20 minutes later. They found that the gas supply had been shut off at the house meter and began a leak search immediately. At 6:45 a.m., while testing around the gas meter, a small leak was found, but this proved to be a minor thread-connection leak. The crew continued to test for leaks north along the service line to its junction with the gas main. A "spotting bar" was used to punch a 1/2-inch-diameter hole close to the service line, and the probe from the combustible-gas indicator was inserted into this hole. Any vapors present were drawn into the instrument and registered.

These combustible-gas indicator readings varied widely until the gas crews were actually testing the area at the junction of the main and service line. At this location, high gas vapor readings were obtained, and the crew then started checking west along the main, and south up the front lawn of the house alongside its sewer line. The valves on the gas main serving this area were not closed at this time.

Explosion and fire at 8304 Jerrie Jo Drive.

At approximately 7:39 a.m., while firemen were still inside the house at 8300 Jerrie Jo Drive and while gas company personnel were still checking for leakage in front of this house, the woman who lived at 8304 Jerrie Jo Drive walked into her garage to turn off the lights. As she moved the switch, a violent explosion occurred, followed by an intense, but short-lived fire in the garage itself. (See Figure 4.) The woman was hurled across the

garage floor by the force of the explosion and incurred third-degree burns over 90 percent of her body. She was taken by ambulance to a hospital, where she died as a result of her injuries.

The garage burned, and fires also started at the west edge of the concrete driveway and underneath the concrete slab at the northwest corner of the garage. The firemen who were already on the scene extinguished the garage fire immediately, but allowed the flames underneath the garage and driveway to burn themselves out.

Activities After the Accident

North Richland Hills Fire Department.

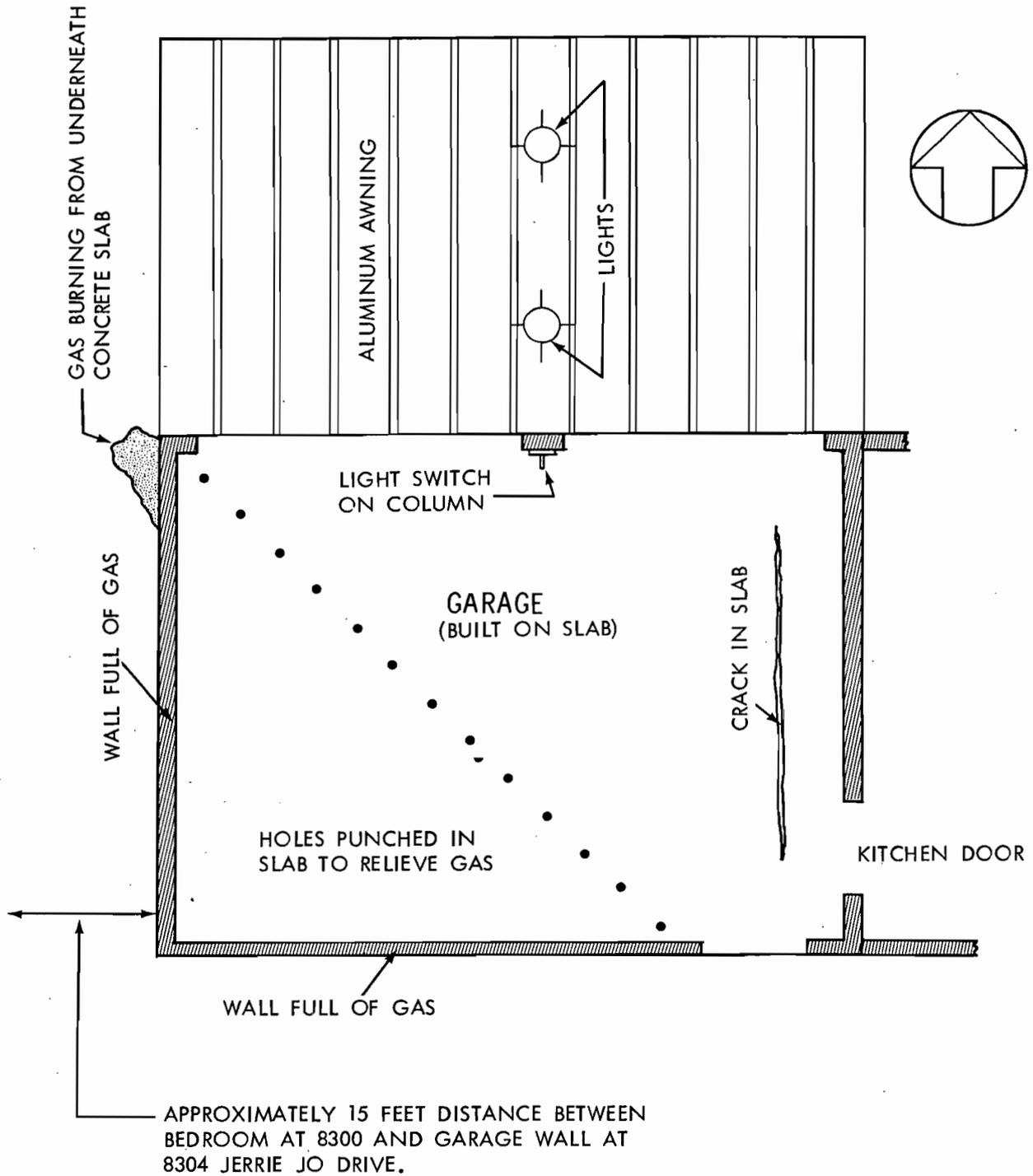
After the second explosion and the fire, the fire marshal called for additional fire equipment as well as for police units to aid in evacuating and sealing off the area within a four-block radius of the disaster.

At no time between the explosion and fire at 8300 and the explosion at 8304 Jerrie Jo Drive was the fire department positively aware of a gas leak or a service-line break. Lone Star personnel at the scene did not establish adequate liaison with the fire company nor did they inform them of their activities.

Lone Star Gas Company. Additional Lone Star crews arrived between 8:15 and 8:30 a.m. and started testing the service and sewer lines of the other houses in the neighborhood. They turned off the gas to each of these dwellings at the meters and then removed the meters. During this same period other gas crews were looking for the leak near the driveway at 8304 Jerrie Jo Drive, where gas pockets had been discovered. At about 8:30 a.m. one crew located and repaired a leak in the service line at its junction with the 6-inch

Figure 4

GAS IN WALLS AND UNDER GARAGE SLAB AT 8304 JERRIE JO DRIVE



gas main. Gas was leaking at 20 to 25 p.s.i.g. from a crack in the threaded connection where the service line was screwed into the 90-degree elbow. (See Figure 5.) The break in the pipe thread was bright and shiny; corrosion had not started.²

The soil immediately over the leak had dried out a little, but the grass above the leak and the shrubbery nearby were not noticeably affected; no plant life was destroyed and no soil discoloration was seen.

The gas regulator taken from the house at 8300 Jerrie Jo Drive was tested in the Lone Star meter repair shop and was found to be operating well within the set limits.

Consulting engineers investigation. Lone Star retained a professional engineering company to investigate the accident site and report on the fires and explosions. This investigation revealed migration of gas in a well-defined but narrow area, extending from the leak at the main and service-line junction up under the driveway and garage at 8304 to the concrete foundation slab at 8300 Jerrie Jo Drive. At 8300, accumulations of gas were found under a bathtub and around an anchor bolt between the den and garage of the house. (See Figure 6.)

Pipe metallurgical analysis by the National Bureau of Standards. The broken service line and the 90-degree elbow into which it had been screwed were sent to the National Bureau of Standards for analysis. The failed pipe section, which had a 1¼-inch nominal outer diameter and a nominal wall thickness of 1/8 inch, consisted of a standard steel pipe with a thin zinc coating over the exterior surface. The pipe thread had cut through this galvanized coating completely, penetrated into the iron base metal, and exposed both

²Two additional leaks were later found: a minor valve leak at the northwest corner of the yard at 8300 Jerrie Jo and a minor leak in the service line at 8308 Jerrie Jo.

the iron and zinc surfaces. The cut thread acted as a stress concentrator at that point.

Metallic zinc coating, when adjacent to iron and exposed to water and oxygen, forms a galvanic cell and releases hydrogen at the iron surface. This hydrogen is then absorbed by the iron, thus creating a brittleness in and reducing the notched tensile strength and ductility of the metal.

A test using an electron microscope revealed that the pipe section had suffered a brittle, faceted cleavage, rather than a ductile, tensile failure.

A second test was conducted on the same pipe near the point of failure. Two notched specimens were exposed to hydrogen across their iron faces while two other notched specimens were left unexposed. The two exposed hydrogenated specimens when notched and pulled apart had brittle faceted cleavage fractures, while both unexposed specimens had very tough, dimpled-rupture ductile fractures. In averaging the tests on the four specimens, the unexposed specimens required 18,050 p.s.i. more stress or 32.1 percent more force to fail than did the exposed specimens. Additionally, the unexposed specimens averaged 21 times more elongation (stretch) before failure than did the hydrogenated specimens.

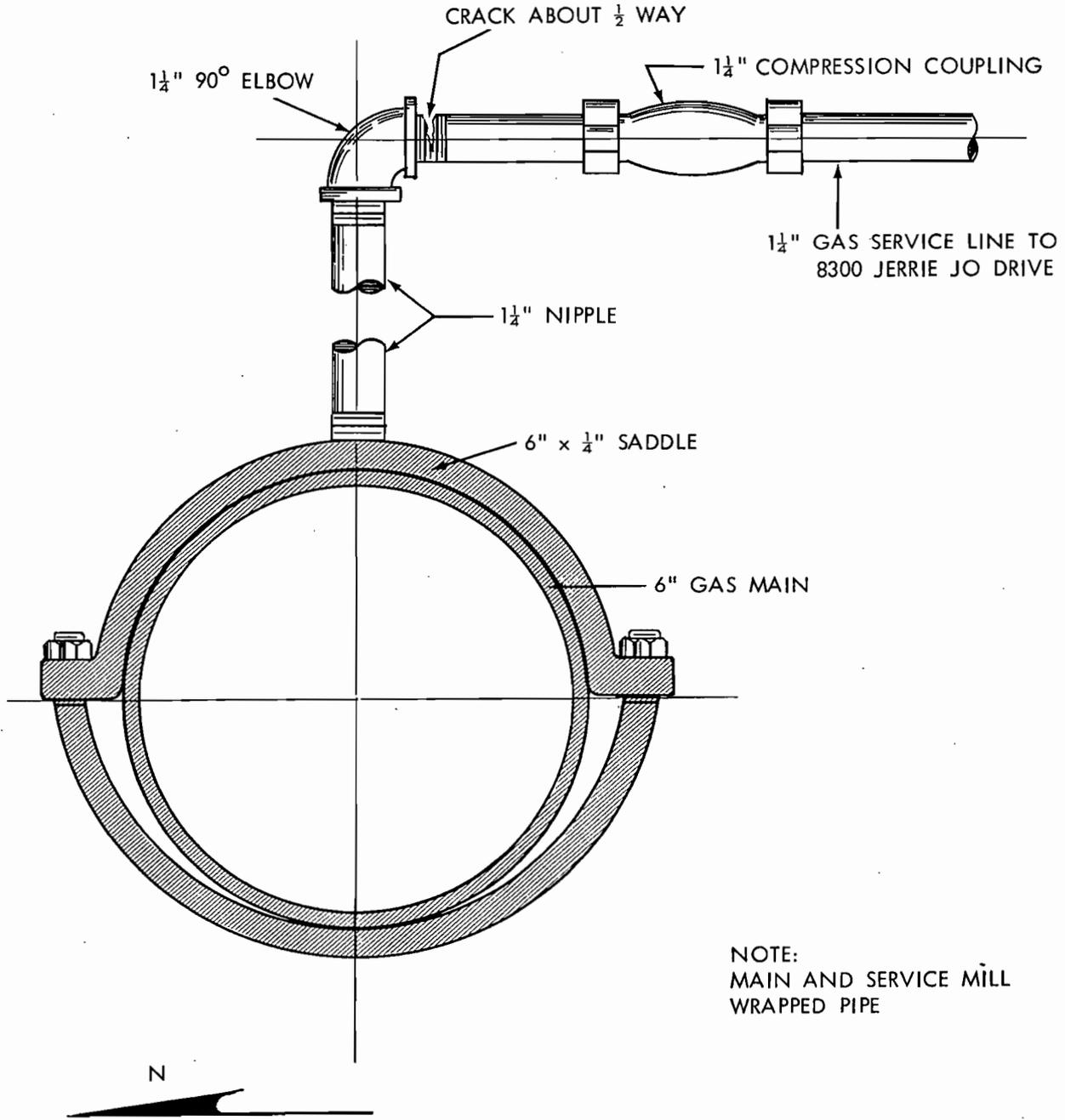
Description of Damage

8300 Jerrie Jo Drive. The fire involved mostly the center and east section of the house, i.e., the living room, dining room, kitchen, and den. The cedar shingle roof over this area was burned through completely. The remainder of the house showed the effects of extreme heat and heavy smoke. (See Figure 7.) The damage was judged later to be irreparable and the house was a total loss.

The outside east wall of the house, next to 8304, was bulged out. The inside wall of the

Figure 5

BROKEN SERVICE LINE CONNECTION



NOTE:
MAIN AND SERVICE WILL
WRAPPED PIPE

Figure 6
**PATH OF MIGRATING GAS BETWEEN
 8300 AND 8304 JERRIE JO DRIVE**

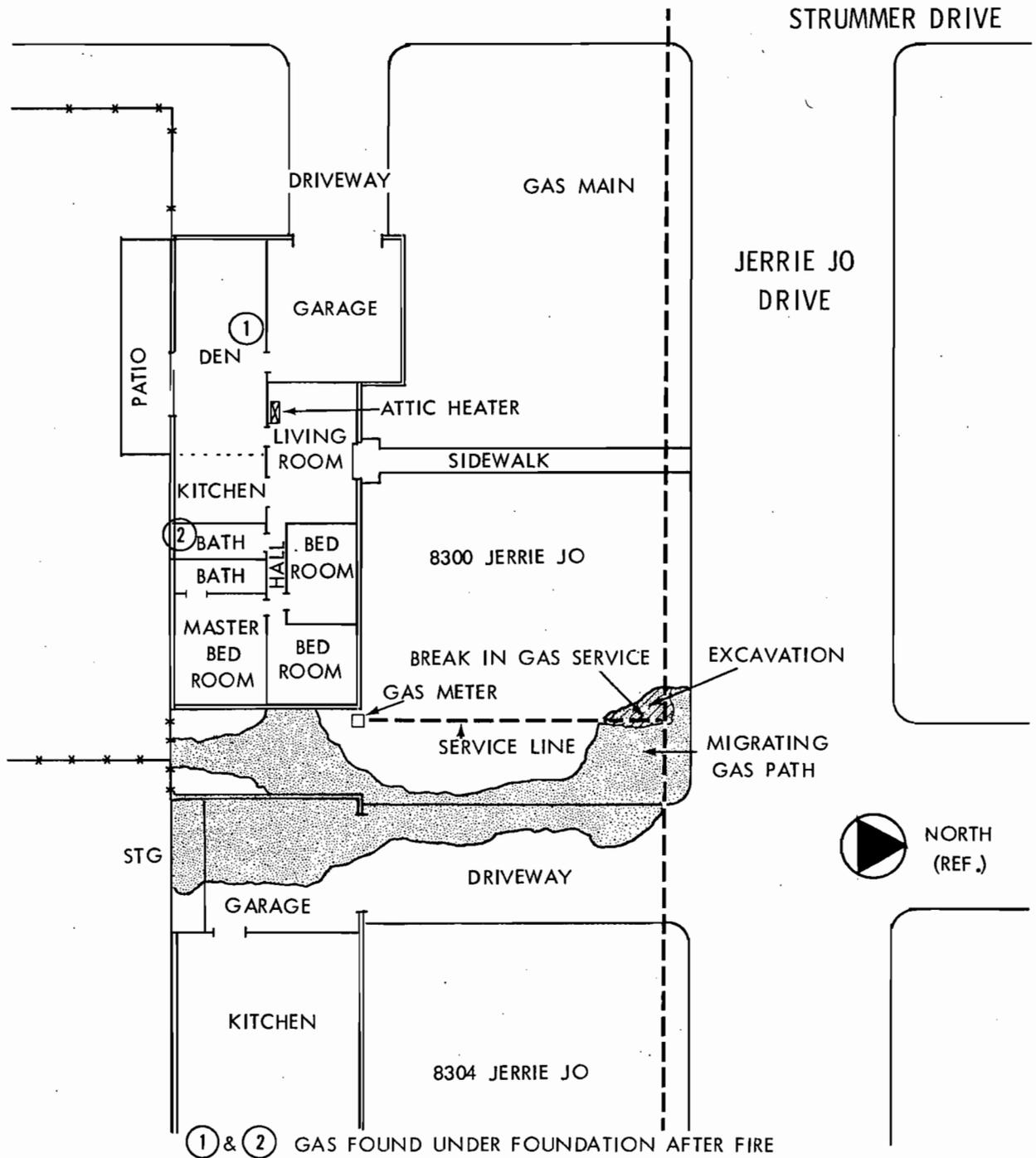




Figure 7: Interior of house at 8300 Jerrie Jo Drive after the explosion and fire.

northeast bedroom was similarly bulged out and pulled away from the interior wall. The interior wall was also forced outwards about 6 inches. The ceilings of this bedroom and the master bedroom had been raised 4½-inches above their normal position.

The drapes on the south window of the master bedroom were lodged in the attic area between the ceiling and the east wall. Broken glass was lying on the carpeted floor below this window. This glass was smoke-stained and heat-discolored, but the carpet was not.

In the northeast bedroom, the drapes on the north window were blown into a tree 25 feet away; they were neither scorched nor

stained. The curtain rod, which was still attached to the curtains in the tree, had been torn out of the wall.

In the attic, the gas line feeding the pilot light of the combination heater - air-conditioner had a broken coupling, melted on one side but torn on the other.

8304 Jerrie Jo Drive. The explosion blew out the double-door section of the garage and scattered debris all over the inside of the garage as well as on the concrete apron in front. Inside the garage, the walls were cracked and buckled by the blast; the northwest and south walls had been pulled inward about 2 feet and showed the effects of the

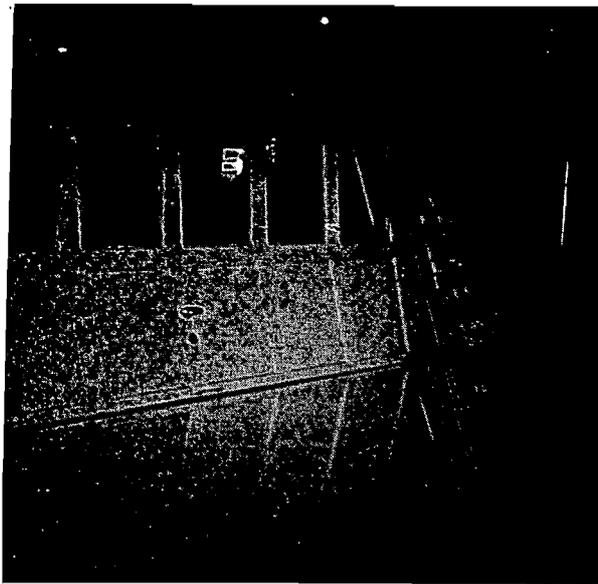


Figure 8: Garage doors and damaged support column at 8304 Jerrie Jo Drive.

intense fire which followed the blast. All the windows had been broken and the main support column between the two double doors had been blown out at the base. (See Figure 8.) Gas that was trapped underneath this slab was later relieved through holes drilled in the concrete slab.

Standards

At the time of the installation of the distribution system involved in this accident, there were no Federal standards dealing with the design, construction, or testing of pressure piping. The Lone Star Gas Company, however, voluntarily complied with the version of the American Standard Code for Pressure Piping then in effect.³ Chapter III of the

³in 1966, the American Standards Association changed its name to the United States of America Standards Institute (USASI). The USASI is now known as the American National Standards Institute (ANSI).

code, "Piping System Components and Fabrication Details," stated the following:

"835.3 Restraint Due to Soil Friction. Where there is doubt as to the adequacy of anchorage by soil friction, calculations should be made.

"835.4 Forces on Pipe Joints .

If anchorage is not provided at the bend (835.2) pipe joints which are close to the points of thrust origin shall be designed to sustain the longitudinal pullout force. If such provision is not made in the manufacture of the joint, suitable bracing or strapping shall be provided, unless calculations show the joint to be safe."

The service-line break suggests that Lone Star's compliance with these two sections of the code may not have been total.

Federal regulations regarding gas emergencies were in effect on the day of the accident. Each operator is required by 49 CFR 192.615 to:

"(a) Have written emergency procedures;

* * * * *

(c) Establish liaison with appropriate public officials, including fire and police officials, with respect to the procedures; and

(d) Establish an educational program to enable customers and the general public to recognize and report a gas emergency to the appropriate officials."

III. ANALYSIS

The Accident

The 13-year-old galvanized service-line connection had become brittle in the thread cut

zone due to hydrogenation. Because the ability of the pipe to stretch and yield in tension without failure had been limited severely, the safety factor had been reduced. Ungalvanized pipe or the same galvanized pipe without the hydrogenation effects would have been able to withstand over 30 percent more tensile force and to suffer more than 20 times the elongation before fracture occurred.

The dense clay soil had exerted stresses on this pipe through the years every time rain saturated the soil sufficiently to cause it to swell. This soil-stress condition was recognized and, because full basements would ultimately buckle, most houses were built on concrete slabs. The soil swelling caused by the heavy rains preceding the accident finally broke the embrittled pipe and allowed gas to escape.

The dense clay, having caused the pipe failure, prevented the escaping gas from dissipating to the air above and caused it to flow away from the break laterally into the more porous, graveled soil under the driveway, 10 feet east of the leak. Once the gas, induced by the 20-p.s.i.g. pressure, had established an avenue into the more porous area, it migrated up under the driveway and flowed into and accumulated under the concrete slabs of both houses. Throughout this migration, the gas was effectively capped, first by the clay over the leak site and then by the concrete driveway and foundation slabs under the two houses.

At 8300 Jerrie Jo Drive, this accumulated gas seeped into the living area around a foundation bolt in the den, underneath the bathtub in the lavatory, and elsewhere through voids or fissures in the concrete. A gas pilot light, an activated thermostat, or possibly an electric light switch operated by the deceased triggered an initial explosion and a hot, but oxygen-starved fire.

The parents escaped through the large glass sliding door which, once opened, provided air for the fire. Thus fed, the fire burned a hole in the roof, which became a flue. The flames that rolled out of the doors at the firemen did not diminish when the gas meter was shut off, because a large accumulation of gas existed under this foundation.

The gas which accumulated under the garage at 8304 Jerrie Jo Drive rose between the walls and mixed with the air in the garage itself. This gas-air mixture was ignited by the arc of the activated light switch.

Holes drilled through the concrete driveway and garage slab at 8304 and through the house foundation at 8300 proved that gas was trapped underneath and showed that a large amount of gas had accumulated.

Contributing Factors

After the first explosion, but before the second one, gas company personnel had already begun a leak search. They knew that the leak was close by, but were unaware of the severity or the extent of gas migration. Because this leak was new, no plant life had been destroyed or discolored.

If, when they realized a leak existed, the gas crew had closed the three valves that would have shut off the gas supply to the affected area, the second accident might have been averted.

Federal regulations do not specifically state when gas valves shall be closed during leak emergencies. A decision of this nature remains a value judgement to be made by the gas company personnel at the accident site. The National Transportation Safety Board, in February 1971, in a study of the shutdown of

failed pipeline systems⁴, discussed this problem and recommended that:

“The Office of Pipeline Safety of the Department of Transportation conduct a study to develop standards for the rapid shutdown of failed natural gas pipelines and work in conjunction with the Federal Railroad Administration to develop similar standards for liquid pipelines.”

Had these guidelines or standards for emergency situations been available, the Lone Star crews would have been in a better position to evaluate and deal with the hazards. The Board is aware, however, that the Department of Transportation is undertaking a study on rapid shutdown of failed pipeline facilities, which may result in improved methods and systems.

Lack of communication and cooperation between Lone Star and the North Richland Hills Fire Department contributed to the magnitude of this accident. If the firemen had been alerted earlier to the leak severity or the gas concentration, more precaution would have been taken and the area probably would have been evacuated before the second accident. Although 49 CFR 192.615 requires gas company liaison with the appropriate public officials, including the fire and police departments, with respect to emergency procedures, it does not explicitly require coordination at the time and place of accident.

IV. CONCLUSIONS

The National Transportation Safety Board concludes that:

1. The zinc coating on the service line combined with air and moisture to

⁴National Transportation Safety Board, *Special Study of Effects of Delay in Shutting Down Failed Pipeline Systems and Methods of Providing Rapid Shutdown*. NTSB-PSS-71-1.

cause a dissimilar metal condition and to set up a galvanic action which ultimately produced the hydrogenation brittle, faceted cleavage of the pipe.

2. The service line, weakened after repeated soil stresses over a period of years and embrittled by hydrogenation, finally failed due to the forces exerted on it by the swelling clay, which was saturated by recent heavy rains.
3. The explosion and fire in the house at 8300 Jerrie Jo Drive were due to natural gas leaking at 20 to 25 p.s.i.g. from a break at the junction of the gas main and service line.
4. The explosion and fire in the house at 8304 Jerrie Jo Drive, which occurred almost 3 hours later, were due to natural gas still leaking at 20 to 25 p.s.i.g. from the break at the junction of the gas main and service line and migrating in a well-defined path up under the concrete driveway and garage slab.
5. Lone Star Gas Company employees and fire department personnel did not establish proper liaison or communication. Thus, the firemen were unaware of the leaking gas.
6. This lack of communication resulted in the late evacuation (after the second explosion) of the area residents still unaffected.
7. The fact that gas company employees did not close the three valves on the gas main to isolate the affected section contributed to the amount of gas released, and to the severity of the second explosion.

V. PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the explosions and fires was the ignition of an

accumulation of natural gas which had leaked from a broken service-line connection with a 6-inch gas main and had migrated up and under the concrete slabs of both houses.

The length of time taken by gas company personnel to find the leak and their failure to close the three valves of the gas main to isolate the affected area contributed to the second explosion and fire.

The delay in the decision to evacuate the houses until after the second explosion and fire was caused by lack of liaison and cooperation between the gas company and the fire department.

VI. RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Office of Pipeline Safety

(a) Amend 49 CFR 192 to include a section based on a review of the suitability of threaded galvanized pipe, or pipe coated with other dissimilar metals, for the transportation of natural and other gas. (Recommendation No. P-72-34)

(b) Amend 49 CFR 192.615 to include an explicit requirement that pipeline operators notify and coordinate their activities with local fire and police officials when gas leaks create hazardous conditions. (Recommendation No. P-72-35)

2. The American Society of Mechanical Engineers Gas Piping Standards Committee:

Conduct, in conjunction with the American Gas Association, a study

of the stress effects of various types of soils and backfill on service line-gas main connections. As a result of this study, guidelines should be issued for installing underground gas-piping systems. (Recommendation No. P-72-36)

3. The Lone Star Gas Company:

(a) Undertake a program acceptable to the Railroad Commission of the State of Texas, to inspect, on a random-sample basis, the service line - gas main connections similar to those at the accident site, to determine their current condition and the existing stress on the piping. The results of this program will determine the action to be taken on other installations in the Lone Star system. Copies of these test results should be forwarded to the Railroad Commission of the State of Texas and the Office of Pipeline Safety of the Department of Transportation. (Recommendation No. P-72-37)

(b) Establish a line of communications and hold periodic meetings with local fire departments and other interested agencies to inform them of gas company emergency procedures and maintenance operations. (Recommendation No. P-72-38)

(c) Notify and coordinate its activities with local fire and police officials when gas leaks create hazardous conditions. (Recommendation No. P-72-39)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

Louis M. Thayer, Member, was not present and did not participate in the adoption of this report.

November 8, 1972

APPENDIX A

SOIL AND PLANT LIFE AT THE ACCIDENT SITE

The following is a report of observations on conditions of grass, shrubs, and soil at 8300 and 8304 Jerrie Jo. These observations were made on October 11, 1971.

"The soil at these two locations is a dark (Black) colored clay. The clay which normally make up soils of this type are high in montmorillonite and montmorillonite type clays. This means that these soils normally swell and shrink upon wetting and drying.

"Drying causes these soils to crack. The degree of cracking depends upon the degree of drying and the amount of clay. Soils may crack at one level and not at others due to the amount of and frequency at which moisture is received. Many times home owners do not apply enough water to lawns, in periods of extreme dry weather, to keep their soil moist below the top one foot. Even in well-cared for lawns sub-surface cracks could exist. These cracks would disappear when enough moisture is received to cause the clays to swell.

"When cracks are formed and then filled the soil structure is normally altered to some extent in the area of the crack.

"An examination of the soils both at 8300 and 8304 revealed that like most housing developments the soils were disturbed to some extent. Both soils contain about the same amount of sand, silt, and clay. This was true at most soil depths.

8304	% SAND	% SILT	% CLAY
Surface	38.4	22.0	39.6
15" - 24"	36.4	21.0	42.6
Below 24"	38.4	21.0	40.6
8300			
0 - 18"	38.4	20.0	41.6

"Soils on both lots would normally swell and shrink to some extent. I do not know what forces would be exerted during cracking. Because of the late summer and early fall rains the soil was filled to capacity with moisture and did not have any open cracks on October 11, 1971.

"The soil on 8300 at least on the 8304 side of the lot contained some gravel. This gravel or possibly old cracks or other soil conditions not observed could account for the natural gas distribution in the soil.

"Clay soils normally have very small pores. This causes air and water to move through the soil very slowly. However, because of the gravel in the soil of 8300 and possibly old cracks gas could have moved one direction faster than another.

"The vegetation on both lots (8300 & 8304) appeared to be normal and healthy with one exception. One shrub near the property line and near the houses was showing signs of a problem that might be due to the presence of natural gas in the soil. A few other shrubs showed signs of heat damage.

"The grass on both lots seemed to be in good shape. It was green and had a fairly good turf. 8304 had the best lawn of the two. This was probably due to past care. The grass between the two houses was not in good condition. This appeared to be due to excess traffic and shade.

"I would judge from the condition of the grass and the shrubs that large quantities of natural gas had not been present in the soil for an extended period of time. This is not to say that smaller quantities could not have been present for some time. For the vegetation to show some effect the majority of their root area would have to have been affected by the gas."