Missouri Public Service Commission

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Missouri Public
Service Commission

Mr. Dale Hardy Roberts
Secretary/Chief Regulatory Law Judge
Missouri Public Service Commission
P. O. Box 360
Jefferson City, MO 65102

RE: Case No. GS-2000-673

Dear Mr. Roberts:

Enclosed for filing in the above-captioned case are an original and eight (8) conformed copies of a **GAS INCIDENT REPORT.**

This filing has been mailed or hand-delivered this date to all counsel of record.

Thank you for your attention to this matter.

Sincerely yours,

Bruce H. Bates
Assistant General Counsel
(573) 751-7434
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Enclosure
cc: Counsel of Record

Service List for
Case No. GS-2000-673
September 7, 2000

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Missouri Public Service Commission

Gas Incident Report

Laclede Gas Company
Case No. GS-2000-673

416 Boyce Avenue
Farmington, Missouri
March 25, 2000

Gas Safety Section ... Gas Department ... Utility Operations Division
September 2000 Jefferson City, Missouri

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SYNOPSIS

At approximately 3:15 p.m., Central Standard Time (CST), on Saturday, March 25, 2000, natural gas was ignited and an ensuing fire occurred at 416 Boyce Avenue (416 Boyce) in Farmington, Missouri. Fire damage was primarily localized to the kitchen area, but smoke damage was present throughout much of the ground floor of the two-story residence. Total damage was estimated at $20,000. Five individuals were inside the residence when the natural gas was ignited. One individual, who was working in a crawlspace beneath the kitchen floor, suffered burns to his face and right arm. He refused initial medical attention, but sought medical treatment on March 29 in Columbia, Missouri, where he was treated for 2nd degree burns and released. There were no fatalities resulting from the incident.

Missouri Natural Gas Company, a Division of Laclede Gas Company (Laclede or Company), provides natural gas service in Farmington, Missouri. A 4-inch diameter, coated and cathodically protected steel natural gas main (4-inch main) supplied natural gas to a ¾-inch diameter, coated and cathodically protected steel service line (¾-inch service). The 4-inch main and connecting service line were operating at a pressure of approximately 24 pounds per square-inch gauge (psig) at the time of the incident. The maximum allowable operating pressure is 30 psig.

The Missouri Public Service Commission's Gas Department – Safety/Engineering Staff (Staff) has determined the incident resulted from natural gas escaping from three corrosion holes on the 4-inch main, located beneath the street in front of 416 Boyce. The escaping natural gas migrated to a sewer main located less than 27 feet away from the corrosion holes, entered the sewer lateral for 416 Boyce, and into the structure beneath the kitchen. Family members of the residents of 416 Boyce were installing a shower unit and in the process had separated the house sewer piping in a crawlspace area beneath the kitchen. Two family members standing in the kitchen smelled natural gas shortly after another family member separated the sewer drainpipe. Thinking a recently replaced gas range knob had become disoriented and that the valve was in the 'on' position, but the burner was not lit, a family member began operating controls on the range, which is believed to have ignited the accumulated natural gas.

At approximately 3:25 p.m. on March 25, the Farmington Fire Department notified Laclede that a fire occurred at the residence of 416 Boyce. The first Laclede personnel arrived on-site at 3:54 p.m. that Saturday and proceeded with initial investigations. By 5:40 p.m., Laclede personnel in Farmington reached a consensus that they were involved in a "gas-related" incident. Company investigations continued while initial excavations were begun at approximately 10:30 p.m. Saturday night. Gas-in-air readings greater than, or equal to, the natural gas lower explosive limit were obtained from the sewer system until excavations were initiated. Excavations and repairs to the natural gas pipelines continued

until Monday, March 27. A total of four corrosion repairs were made to the 4-inch main and ¾-inch service.

Before backfilling on Monday, March 27, Laclede employees at the site discussed whether Laclede's Claims Department, located in St. Louis, had been contacted by Company dispatchers and given information regarding the incident and whether the Missouri Public Service Commission (MoPSC or Commission) should be contacted. Laclede's Claims Department in St. Louis is responsible for notifying the Commission of incident-related conditions involving natural gas. Laclede's Claims Department was contacted by the Missouri Natural Gas division on Monday, March 27, and it was determined the Commission should be notified. The Commission received notification of the incident on March 27 at approximately 2:00 p.m.

Based upon the evidence collected during this investigation, the Staff has determined that sufficient evidence exists to conclude that Laclede violated Missouri Public Service Commission (MoPSC) Regulations 4 CSR 240-40.020(4)(A), regarding reporting requirements of a natural gas incident to the MoPSC; and, 4 CSR 240-40.030(14)(C), regarding actions to protect persons and property subsequent to the natural gas flash fire. The Staff found no probable violations of MoPSC pipeline safety regulations that contributed to the incident.

Five recommendations to Laclede are being made as a result of the Staff's investigation. Three of these recommendations pertain to probable violations of MoPSC pipeline safety regulations that occurred as a result of Laclede's subsequent emergency repair and reporting actions.

FACTS

NOTE: Except for the information gathered during the on-site investigation and/or interviews, the information used to compile this report was obtained in record and/or statement form.

The Incident

At approximately 3:15 p.m., CST (all times in this report are CST), on Saturday, March 25, 2000, natural gas was ignited within 416 Boyce, a single-family dwelling in Farmington, Missouri. Once ignited, the burning natural gas caused an ensuing fire in the kitchen of the home.

Personal Injuries

Two residents of 416 Boyce and three family members were inside the home when the natural gas was ignited. Only one family member was injured. He suffered burns to his face and right arm as a result of a flash fire produced from the ignition of natural gas. He refused initial medical attention on March 25, but sought medical treatment in Columbia, Missouri, on March 29 where he was treated for 2nd degree burns and released. There were no fatalities as a result of the incident.

Property Damage

Visible property damage to 416 Boyce was confined to the interior of the home. The interior of the residential structure exhibited smoke and heat-related damage as a result of the ensuing fire and overhaul[1], with fire and heat damage most visible in the kitchen area. The total value of structural and material damage suffered as a result of the incident was estimated by Laclede to be approximately $20,000.[2]

Site Description

416 Boyce is a two-story, single-family dwelling located in Farmington, Missouri. The house occupies the southeast corner lot at the intersection of the Boyce Avenue and Perrine Road (Boyce/Perrine intersection), approximately 58 feet south of the south pavement edge of Boyce Avenue (See Appendix A-1 and A-2, Figures 1 and 2). The home has a small basement that opens to a crawlspace

[1] Overhaul is defined as the process of looking for a hidden flame or spark that may rekindle a fire.
[2] Information obtained from the RSPA F 7100.1 Federal Incident Report form submitted by Laclede to the Staff.

area located under the southeast portion of the structure, providing access to plumbing and electrical wiring, (See Appendix B-3, Photographs 5 and 6). Outside, approximately 27 feet separates the east structure wall of 416 Boyce and the west wall of 414 Boyce.

The sewer lateral to 416 Boyce runs approximately parallel to the east building line of the structure before connecting to the sewer main located under Boyce Avenue. A cleanout for this sewer lateral is located outside at the northeast corner of the structure and approximately 60 feet away from the south pavement edge of Boyce Avenue (See Appendix B-1, Photograph 2). The sewer main "dead ends" in front of 416 Boyce and extends east at approximately the center of Boyce Avenue at an unknown depth.

Residential homes of similar vintage surround 416 Boyce, with the exception of the northeast corner lot of the Boyce/Perrine intersection. A large, relatively open lot occupies this corner of the intersection and contains a City of Farmington water tower and City of Farmington Parks and Recreation Building.

Meteorological Data

The National Climate Data Center recorded a high temperature of 68 degrees Fahrenheit (°F) and a low temperature of 41 °F on March 25, 2000. On this day, there was no precipitation recorded. A high temperature of 72 °F and a low temperature of 35 °F were recorded for March 26, with no precipitation. Monday, March 27, precipitation in the amount of 0.40 inches was recorded, while a high and low temperature of 65 °F and 41 °F were recorded, respectively.

Natural Gas System

Missouri Natural Gas Company (MoNat), a division of Laclede Gas Company (Laclede or Company), provides natural gas service in Farmington, Missouri.[3] Both 414 and 416 Boyce have a ¾-inch diameter, coated and cathodically protected steel service line supplied with high-pressure[4] natural gas from a 4-inch diameter, coated and cathodically protected steel main. The natural gas main is buried approximately 2½ feet below Boyce Avenue and 19 feet north of the south pavement edge, lying in the same east/west direction. While the original installation date of the 4-inch main is uncertain, the

[3] Missouri Natural Gas Company (MoNat) is responsible for service and installation activities in the Farmington area, but for purposes of personnel identification in this report, all MoNat and Laclede personnel will be referred to as Laclede or Company.

[4] MoPSC Regulation 4 CSR 240-40.030(1)(B)10. defines a high-pressure distribution system as "...a distribution system in which the gas pressure in the main is higher than an equivalent of fourteen inches (14") water column", or approximately ½ psig.

service line to 416 Boyce was installed on November 18, 1930. Laclede estimated the natural gas pipelines were operating at approximately 24 psig at the time of the incident. These pipelines have a maximum allowable operating pressure[5] of 30 psig.

The natural gas meter to 416 Boyce is located along the west building line of this structure. The ¾-inch service to 416 Boyce extends approximately 96 feet north, where it taps into the 4-inch main, paralleling Perrine Road. The service line for 414 Boyce is approximately 35-40 feet east of the service line tap for 416 Boyce. As the 414 Boyce service line extends south from the 4-inch main toward the west structure wall, it passes over a sewer main and near a sewer manhole. This sewer manhole is located 19½ feet west of the service line for 414 Boyce. The natural gas service line parallels the property line of 414 and 416 Boyce, and the sewer lateral for 416 Boyce (See Appendix A-2, Figure 2).

Laclede records display four distribution valves within the natural gas system that could be operated to isolate the incident area if needed. The four valves are located at the intersections of: Boyce Avenue/Perrine Road; Boyce Avenue/'A' Street; Boyce Avenue/Jefferson Street; and, Jefferson Street/Harrison Street. Laclede stated 119 customers would be isolated upon operating the four natural gas distribution valves and would require approximately 3½ hours to relight.

Previous Company Actions

•Previous Repairs•

Repairs were previously made on March 11, 1946, to the 416 Boyce service line near the south pavement edge of Boyce Avenue. Company leak repair records indicate a large rock was found lying on top of the ¾-inch service line. Prior to the incident, no other repairs, excluding the installation of sacrificial anodes and cathodic protection test stations noted below, have been made to either the 416 or 414 Boyce service lines or the connecting 4-inch main segment located in front of the residences.

•Leak Survey Investigations•

Laclede is required to leak survey the mains and service lines along the 400 block of Boyce Avenue every three years by Commission Regulation 4 CSR 240-40.030(13)(M)2.B.[6] During the most recent

[5] MoPSC Regulation 4 CSR 240-40.030(1)(B)16. defines the maximum allowable operating pressure as the maximum pressure at which a pipeline or segment of a pipeline may be operated.

leak survey conducted in April 1998, no leaks were detected over the 4-inch main or adjoining service lines along the 400 block of Boyce Avenue.

For over six months prior to the incident, no trouble odor notifications from the 400 block of Boyce Avenue were made to Laclede.

•Cathodic Protection•

For the steel natural gas pipelines along Boyce Avenue, the Company monitors the level of cathodic protection - a process of protecting metallic pipelines from corrosion - annually, as required by the minimum pipeline safety rules.[7] During the most recent cathodic protection survey (September 1999), potential readings of -1.13 volts at 415 Boyce and -1.15 volts two blocks east at the Boyce Avenue/Walnut Street intersection were taken for the 4-inch main. Three prior annual Company cathodic protection surveys indicated adequate levels of cathodic protection, -0.85 volts or more negative, at a test station located at the service riser for 331 Boyce.

A 17 pound (lb.) anode was installed at the 331 Boyce service riser in April 1984. At the valve location in the Boyce/Perrine intersection, the Company installed four sacrificial anodes on the 4-inch main in February 1990. A -0.86 volt reading, less negative by more than 300 millivolts from the year before, was obtained during the Company's September 1996 cathodic protection survey at the 331 Boyce service riser and prompted actions in March 1997. Laclede's actions corrected an electrical short between a water pipeline and the natural gas main at 501 Taylor St., and installed a test station and a 32 lb. anode at both the Taylor Avenue and Walnut Street intersections with Boyce Avenue.

•Odorization Records•

Laclede is required to maintain the odorant levels in natural gas to be readily detectable at a concentration of less than 0.90 percent gas-in-air (% gas).[8] Each month Laclede checks several odorant concentration test points that are selectively distributed throughout the Farmington natural gas distribution system. Company records of monthly odorant readings taken for six months prior to the

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[6] MoPSC Regulation 4 CSR 240-40.030(13)(M)2.B., requires leakage surveys to be conducted outside principal business districts using a leak detection instrument at intervals not exceeding 39 months, but at least once each third calendar year for all pipelines other than unprotected steel pipelines and yardlines.

[7] MoPSC Regulation 4 CSR 240-40.030(9)(I)1., states that each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding fifteen (15) months, to determine whether the cathodic protection meets the requirements of subsection (9)(H).

[8] MoPSC Regulation 4 CSR 240-40.030(12)(P)1. requires the odorant in natural gas distribution pipelines to be readily detectable at a concentration in air of one-fifth of the lower explosive limit, or less, which is approximately 0.90% gas-in-air, or less.

incident indicated the natural gas was adequately odorized and readily detectable, no readings exceeded 0.43% gas. Laclede obtained a readily detectable concentration of 0.31% gas at 416 Boyce on March 28, 2000.

Company Notification and Actions

• Initial Notification of Incident and 1st Hour of Investigation •

Laclede's central dispatching in St. Louis, Missouri, received a notification from the Farmington Fire Department (fire department) at 3:25 p.m. on Saturday, March 25, 2000, indicating a house fire occurred at 416 Boyce. The call was immediately dispatched to a Laclede serviceman who arrived on-site at 3:54 p.m. In addition, the same dispatcher notified a Company Service Foreman who did not respond to the scene, but acted as a coordinator and a central contact for calls during the incident.

The initial responding serviceman contacted the Service Foreman at 4:10 p.m., informing him that initial gas-in-air readings of 50% were taken at the sewer manhole (in front of 416 Boyce). After the manhole cover was removed, 4.5% gas readings were obtained at the same location. Additionally, the serviceman relayed the fire department's general description of the event, including information that the fire looked as if it was coming from the sewer. The Service Foreman asked whether the main or service line had been bar holed [9], and the serviceman indicated he "hadn't had time yet". In response, the Service Foreman instructed that, "we need to get in those other houses and I'm going to call and get you some help." The serviceman then continued his leak investigations surrounding the Class 1 leak.[10]

The Service Foreman then contacted another Service Foreman who responded to the scene at approximately 4:40 – 4:45 p.m. on March 25. This second Service Foreman also performs the duties of a claims representative for the Missouri Natural Gas service territory and will be identified as a 'Claims Assistant' for the remainder of this report. At the time of the incident, the Claims Assistant had been performing the duties of this position for 2 months.

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[9] Bar holes are small diameter holes made in the ground by a steel rod to facilitate sampling of the subsurface atmosphere for natural gas with a combustible gas indicator.

[10] MoPSC Regulation 4 CSR 240-40.030(14)(C)1. defines a Class 1 leak is a gas leak, which, due to its location and/or magnitude, constitutes an immediate hazard to a building and/or the general public. It shall require immediate corrective action which shall provide for public safety and protect property. Examples of Class 1 leaks are: a gas fire, flash or explosion; ... an indication of gas present in a building emanating from operator-owned facilities; a gas reading equal to or above the lower explosive limit in a tunnel, sanitary sewer or confined area; gas entering a building or in imminent danger of doing so; and any leak which, in the judgement of the supervisor on scene, is regarded as immediately hazardous to the public and/or property.

Several contacts were made among Company personnel, all working in the Farmington service area, which resulted in additional service personnel being sent to the scene. Laclede's dispatch center was also called and provided an update at approximately 4:48 p.m. on March 25. In recollection, the Service Foreman believed he told the dispatcher that a fire had occurred at 416 Boyce, the fire department thought the fire looked as if it came from around the sewer, and natural gas was detected in the sewer. In his descriptions to the dispatcher, the Service Foreman says the event was described as "possibly" gas related, but not confirmed as gas related, and that dispatching would be contacted later with an update. This was the last contact the Service Foreman had with dispatching on Saturday, March 25.

The Superintendent of Service, who had been advised that a sewer pipe located beneath the home had been involved in the fire, was the second Company personnel to arrive on-site on March 25, minutes before the Claims Assistant. The Superintendent of Service, aware the initial responding serviceman was conducting bar hole leak surveys outside, began his investigation of the incident. Fire and police department personnel advised him of the events that had taken place to that point, including information that the natural gas meter to 416 Boyce had been shut-off.

Once inside the kitchen of 416 Boyce, the Superintendent of Service observed the damage and was informed that prior to his arrival, a policeman had extinguished a fire emanating from a sewer pipe located in the crawlspace beneath the kitchen floor. He also became aware that two family members standing in the kitchen smelled natural gas shortly after another family member separated the sewer drainpipe. Further information gathered indicated that a family member turned on the gas range thinking that a recently replaced range knob had become disoriented and that the valve was in the 'on' position, but the burner was not lit. He also observed that the sewer pipe was visible from the kitchen because the fire department had removed the natural gas range and cut a hole, approximately 18-inches square, in the floor (See Appendix B-2, Photograph 3). The initial responding serviceman and the Superintendent of Service obtained a sustained reading of 26% gas taken from within the sewer pipe beneath the floor.

The Company employees continued their investigation and bar hole leak surveys, detecting 1.3% and 1.4% gas on the east and west sides, respectively, of the driveway to 414 Boyce. A 20% gas reading was obtained from a valve box at the Boyce/Perrine Road intersection (See Appendix A-2, Figure 2). A fourth Company employee, a serviceman, arrived approximately 50 minutes (4:45 p.m.) after the initial responding serviceman.

The Fire Department initially advised Laclede personnel that the residents of 414 Boyce Avenue had left the area and had arranged for access to the home. By approximately 5:00 p.m., the residents of 414 Boyce Avenue had returned home, but were then requested to remain clear of the area.

• The Company's 2nd and 3rd Hours of Investigation •

The Service Foreman contacted Company construction personnel at approximately 5:15 p.m. Saturday evening (March 25). Approximately 25 minutes later, the Superintendent of Service, who was on-site, requested that a Construction Supervisor be dispatched to the scene. At approximately 5:40 p.m., the Service Foreman and Director of Operations conversed, agreeing that it was "pretty probable" the incident was gas related, and that "some problems" existed. During this telephonic conversation, it was indicated Laclede's Claims Department in St. Louis should be notified. The conversation between the Service Foreman and Director of Operations ended with no confirmation as to who would actually make the necessary calls to inform Laclede's Claims Department.

Two Construction and Maintenance (C&M) employees arrived on-site at 5:50 p.m., one was instructed to locate the natural gas lines in the area while the other went to the shop to obtain equipment needed to begin a leak investigation in the asphalt of Boyce Avenue. By 6:10 p.m., Laclede had seven Company personnel on-site. By 6:20 p.m., approximately 2½ hours after the Company's initial arrival, Laclede began to "air-jack"[11] the subsurface soil in front of 416 Boyce.

At 6:20 p.m. on March 25, approximately 2½ hours after initial arrival, the Company continued to expand its leak investigation to now include both sides of Boyce Avenue, from Perrine Road to 'A' Street (See Appendix A-1, Figure 1). Roof vents of 414 and 416 Boyce were checked, with no indications of natural gas. The highest gas-in-air readings (70% - 90%) were obtained through the asphalt over the 4-inch main in front of 416 and 414 Boyce. Subsurface gas-in-air readings resulting from bar-hole surveys taken west of Perrine Road and east of 414 Boyce indicated no presence of migrating natural gas. However, inside the sewer manhole, located in front of 401 Boyce, (approximately one block away from the incident site) a 7% gas reading was obtained. In addition, approximately two blocks away from 416 Boyce, inside a sewer manhole at the Boyce Avenue/'A' Street intersection, 1.2% gas was detected. At this time, 416 Boyce was being ventilated and utilities were shut off. A 20% gas reading (previously 26%) was still being obtained within the sewer pipe below the kitchen floor while the sewer manholes were being vented.

• The 5th and 6th Hours of Laclede's Investigation •

Two Laclede servicemen, while witnessed by the Claims Assistant, conducted a pressure test on the 416 Boyce customer fuel lines at 8:30 p.m. on March 25. The fuel line connecting the natural gas range was sealed prior to the pressure test and other natural gas appliances were turned off. A pressure

[11] A process in which a vacuum is applied to the subsurface through bar holes made in the soil. The vacuum will draw natural gas trapped underground toward the vacuum device, allowing it to be expelled into the open atmosphere.

of 7.9 inches water column (approximately the operating pressure of the fuel piping) was administered to the customer fuel lines. No signs of a leak on the customer fuel lines were indicated.

At 9:40 p.m. on March 25, approximately 5 hours and 45 minutes after initial Company arrival, the leak location became apparent to Laclede. At this time, the Service Foreman was contacted and a backhoe, backhoe operator, and additional personnel were requested to report to the incident site. Following the removal of asphalt, initial excavation began at 10:30 p.m. over the ¾-inch service connection for 414 Boyce to the 4-inch main. This excavation was expanded eastward over the 4-inch main by approximately 2 feet because no leak was found on the ¾-inch service for 414 Boyce. In this area of the excavation, Company records described the soil surrounding the main as "very dry." At this location, approximately 2 feet east of the 414 Boyce service and 22 feet northeast from the sewer manhole in Boyce Avenue, a small corrosion leak was located on top of the 4-inch main.

Once the corrosion leak had been excavated and natural gas was allowed to vent to the atmosphere, only a 1% gas reading was detected in the sewer pipe beneath the kitchen floor inside 416 Boyce. Once the corrosion leak on the 4-inch main was repaired with a Mueller® full encirclement clamp at 12:30 a.m. on Sunday (March 26), no gas-in-air readings were detected inside 416 Boyce, in the adjacent sewer lines, or the bar holes made within Boyce Avenue. The Company also performed a visual inspection of the exposed pipe and bar-holed the sides of the excavation to check for further gas readings. The pipe was determined to be in good condition and no further gas readings were found. After barricading the excavation and securing the area, Laclede concluded its investigation Sunday morning at 1:30 a.m.

Prior to leaving, the initial responding serviceman notified a Laclede dispatcher in St. Louis of his completion time of the job. Duty shifts had occurred and a dispatcher, different from who originally spoke to the Service Foreman, took the call. No indications of a gas-related incident were transcribed by the dispatcher.

Other Company Actions

•Laclede's Investigation – March 26•

The Farmington Police Department called Laclede dispatchers Sunday afternoon (March 26) at 1:08 p.m. to report an outside gas odor at 416 Boyce. Within 24 minutes of being dispatched, the initial responding serviceman from the day before responded and began a leak detection investigation. The bar holes made in the street the night before, near the repair, were checked, and 6% gas readings were obtained. The sewer main, where percentages as high as 50% gas were detected the night before, produced a non-sustained 0.3% gas reading, which quickly dissipated. Additionally, no natural gas readings were detected inside 416 Boyce or over its service line during the serviceman's investigation.

It was the serviceman's opinion after concluding leak investigations of the area that the readings obtained were a result of residual gas from the leak discovered and repaired the night before. No other Company activity took place at 416 Boyce on Sunday, March 26, 2000.

•Laclede's Investigation – March 27•

Laclede C&M personnel returned Monday morning (March 27) around 8:15 a.m. to conduct follow-up leak investigations, to ensure no other leaks existed, before backfilling the excavation over the 4-inch main and ¾-inch service to 414 Boyce. Sustained natural gas readings of 20% were obtained when Company personnel leak surveyed within the excavation over the exposed 4-inch main, leak investigations, therefore, continued. Within 1 hour and 15 minutes from their arrival that morning, Laclede had excavated and placed a Mueller® clamp over a second corrosion leak found on the bottom of the 4-inch main, approximately 3 - 4 feet west of the 414 Boyce service (See Appendix B-4, Photograph 8). This corrosion hole was the largest of the three (a third corrosion leak is described below) found on the 4-inch main, it was approximately the size of a dime.

After repairing the corrosion leak that Monday morning, Laclede exposed the ¾-inch service to 416 Boyce to conduct a pressure test, but another corrosion leak was found when the pressure test failed (See Appendix A-2, Figure 2, Excavation #3). During the initial pressure test, the line was pressurized to 25 psig, but dropped 10 psig after 90 seconds. A Dresser® coupling was installed to repair the small corrosion leak on the ¾-inch service to 416 Boyce before a successful second pressure test was administered.

Laclede continued leak investigations, and a fourth and final corrosion leak was exposed. Excavation #1 was expanded eastward, beyond the first corrosion leak repair, to expose the fourth corrosion leak, the third on the 4-inch main (See Appendix B-4, Photograph 8). Again, Laclede installed a Mueller® clamp to repair the fourth corrosion leak. All repairs were completed by 7:00 p.m. Monday, March 27.

While expanding Excavation #1 on Monday, Laclede began breaking the asphalt in Boyce Avenue, 14 feet west of Excavation #1 to expose the 4-inch main. This excavation, Excavation #2 (See Appendix A-2, Figure 2 and Appendix B-2, Photograph 9) was made to ensure no other leaks existed and to determine the extent of any active corrosion.[12] The 4-inch main's original coating was removed, revealing the pipe wall for examination of additional corrosion. Laclede personnel, who took part in

[12] MoPSC Regulation 4 CSR 240-40.030(9)(F) requires whenever an operator has knowledge that any portion of a buried metallic pipeline is exposed, an inspection of the exposed portion must be conducted. If the pipe is coated, the condition of the coating must be determined. ... If the operator finds that there is active corrosion, that the surface of the pipe is pitted due to corrosion, or that corrosion has caused a leak, it shall investigate by records review and by excavation to determine the extent of the corrosion requiring remedial action.

the excavations, indicated this segment of the 4-inch main was is good condition. All excavations were kept open for Staff's scheduled arrival on Tuesday, March 28.

Communication Between Laclede's Dispatching and Field Personnel

When Laclede dispatchers in St. Louis receive trouble odor calls, a Company form, FORM 1587, is completed, displaying relevant data associated with the nature of the call. Once pertinent information is taken from the caller, the dispatcher contacts a serviceman to respond, as were the steps taken after the Farmington Fire Department reported the incident on March 25. On the backside of FORM 1587, space is provided for the dispatcher to document comments and updates related to the initial call. A serviceman has a FORM 1583, much like the FORM 1587, to record, in part:

1) Information provided from the dispatchers;
2) Date, start and completion time of the job;
3) Comments, and;
4) Results of various inspections made.

As indicated above, the respective employee(s) completed FORM 1587 and FORM 1583 related to the incident. From Laclede's initial notification on Saturday (March 25) to 1:21 a.m. on Sunday (March 26), due to changing work shifts, three different dispatchers had handled the singular FORM 1587 related to this incident. The job start and completion times on the two completed forms correlate, as does the serviceman's employee number noted on the forms. However, the comment sections of both forms differ with respect to the description of the event recorded by dispatching in St. Louis and the initial responding serviceman. Below appears the comments on FORM 1587 documented by dispatching in St. Louis, followed by comments documented on FORM 1583 by the initial responding serviceman.

Dispatcher(s) FORM 1587 (Update and Comments Section)
No injuries - minor fire damage – cause still to be determined – No Co. (Company) prop (property) damaged – no leaks found at mtr. (natural gas meter) set – No leaks found on customer F. (fuel) runs.

Initial Responding Serviceman FORM 1583

Found fire had started in kitchen under floor – found 50% gas in sewer – found 26% at sewer stand pipe under floor – also detected gas over main with Trac – It®. C&M called – Leak found on main and repaired.

The information, which the serviceman recorded on the backside of the form, included details of his inspection of the 416 Boyce gas meter, which was found in the "off" position, gas readings taken at the main, meter, and inside sewer pipe, and indications a leak was found on the main and repaired. The dispatching Form 1587 did not contain this field information. Also, the dispatching department's FORM 1587 was not clear with regard to the time the information was received, nor was the reporting time or source documented.

Laclede's Emergency Procedures and Training

•Laclede's Emergency Procedures•

Laclede employees working in the Missouri Natural Gas service territory are required to follow the off-hour emergency response procedures summarized below.

- When Laclede's Dispatcher receives an off-hour call, advising of a fire, he or she makes contact with the serviceman on call for MoNat.

- The serviceman, upon arriving at the scene, makes contact with the Police or Fire personnel. If they find that the call is more than a fire, e.g., there has been an ignition, an eruption, or an explosion resulting from the escape of natural gas which: 1) results in death; 2) results in personal injury, necessitating in-patient hospitalization; 3) results in estimated property damage, including the cost of gas lost, of $5,000 or more; he will immediately call Laclede's Dispatcher. Laclede's Dispatcher will request that the MoNat Supervisor on call contact the serviceman so that the information can be verified and relayed.

- The Supervisor on-call, will then notify MoNat on-duty Claims Assistant of the incident facts. The Claims Assistant will then contact the Laclede Claims Department person on duty to report the incident. It will then be the

responsibility of the Claims Assistant to proceed to the scene in order to supervise the securing of the area and perform other duties.

- The Laclede Gas Company Operations Supervisor on-call should be made aware of the incident, but will not be required to do anything unless it becomes necessary to send special equipment to the area. This will only take place at the request of Laclede's Claim Department person.

Laclede's procedures were developed, in part, to satisfy the MoPSC pipeline safety rule requirement of notifying the Commission within 2 hours of a reportable incident. An event that qualifies as a reportable incident involves a release of natural gas involving the operator's actions or facilities, or where there is a suspicion by the operator that the event may involve a release of gas involving the operator's actions or facilities, and involves:

1. a) A death;
   b) A personal injury involving medical care administered in an emergency room or health care facility, whether inpatient or outpatient, beyond initial treatment and prompt release after evaluation by a health care professional;
   c) Estimated property damage, including cost of gas lost, to the gas operator or others, or both, of $10,000 or more; or

2. In addition to these specific requirements, an event that is significant in the judgment of the operator, even though it did not meet the criteria above is considered reportable.

In this case, Missouri Natural Gas's operations and maintenance procedures for internal notification, pertaining to monetary assessment of damage ($5,000), were more restrictive than the minimum pipeline safety regulations. Laclede's criterion for a regulatory reportable amount of damage is $10,000.

Laclede has procedures to handle emergency situations listed within its Procedures for Emergencies – Beyond Routine Leak Investigation, last revised March 1996. Included within these Company procedures are actions to be taken for "Uncontrolled Gas Due to Main or Service Damage/Failure." These procedures list the steps to take that are necessary to guard against injury and property damage. Several steps are listed for initial responding Company personnel to apply during their assessment of the scene and investigation, including the appropriateness of digging vent holes, or open manhole covers when necessary to prevent gas from entering buildings. Other steps include: evacuation of occupants; eliminating sources or ignition; and ventilating affected buildings.

•Laclede Personnel Training•

Laclede has a written training program for its employees. This program includes training covering topics such as: (a) recognizing potential ignition sources; (b) recognizing conditions that are likely to cause emergencies; (c) taking steps to control the release of natural gas and minimize the potential for fire or explosion; and, (d) the availability and proper use of specialized tools to be used in a gaseous atmosphere.[13] The Laclede personnel responsible for coordinating Company emergency procedures during the incident are all tenured, field-experienced personnel, and each has received Company training sessions pertaining to their positions. The Claims Assistant is required, in part, to relay incident facts to Laclede's Claims Department and proceed to the scene in order to supervise the securing of an area. The Claims Assistant, however, is not required and was not trained to determine the monetary value of assessed damages.

Laclede's actions subsequent to the incident also encompassed a review of the incident with appropriate Company personnel associated with the incident. As a direct result of a March 31, 2000, review, Company revised reporting procedures were developed. Two training sessions on April 20, 2000, were conducted to address this development of revised reporting procedures.

Incident Reporting Requirements

The Missouri Public Service Commission incident reporting requirements were completed as follows:

1. The MoPSC Staff received a telephonic notice of the incident from a Laclede Gas Company representative at approximately 2:00 p.m. on Monday, March 27, 2000. Staff departed on March 27, but due to the delayed notification of the incident, an on-site Staff investigation was scheduled for the following morning. One member of the MoPSC Gas Safety Section Staff arrived on-site at approximately 8:00 a.m. Tuesday, March 28, 2000.

2. U.S. Department of Transportation form RSPA F 7100.1 was completed on April 25, 2000, and received at the MoPSC on April 25, 2000.

[13] MoPSC Regulation 4 CSR 240-40.030(12)(J)B., requires the operator to train the appropriate operating personnel and conduct an annual review to assure that they are knowledgeable of the emergency procedures and verify that the training is effective.

MoPSC Staff Investigation

• Initial Observations •

Company personnel were on-site when Staff arrived on Tuesday, March 28 and were consulted about the events that had taken place. Laclede gave a brief description of the surroundings, followed by an explanation for each of the three excavations exposing the 4-inch main and the ¾-inch services for 414 and 416 Boyce. Because more than two days had passed since the incident, much of the information gathered on Tuesday (March 28) with regard to the pipeline facilities was based upon Company records, interviews, and observation of completed, but still exposed, repairs.

Evenly distributed bar holes in an east/west direction within the street pavement were viewed along Boyce Avenue. The Staff observed the excavations associated with the corrosion repairs, and the sewer manhole within Boyce Avenue and their proximity to one another. Their physical location was contained within a 25-foot by 70-foot area in front of 416 Boyce.

Three excavations, as previously mentioned, exposed the 4-inch main and service lines to 414 and 416 Boyce. Excavation #1, approximately 16 feet by 4 feet, contained three completed corrosion repairs to the 4-inch main, near the 414 Boyce service tap (Appendix A-2, Figure 2 and Appendix B-4, Photograph 7). Three Mueller® repair clamps were used to complete the repairs in Excavation #1. The condition of the pipe coating, adjacent to the repair clamps, was inspected, understanding the possibility that excavation efforts may have scratched or gouged any exposed original pipe coating. In their assessment of the 4-inch main condition immediately after it was exposed, Company personnel who also inspected the adjacent pipe coating were requested for their opinions, and each described the coating as in good condition when exposed. At this time, all re-coating efforts and final inspections of the 4-inch main prior to backfilling had not been completed (See Appendix B-4, Photograph 8). The floor and walls of the Excavation #1 were also examined for condition of soil. Visible and sparsely dispersed rocks, ranging approximately 3 inches to 5 inches in size, bulged from the floor and walls of the excavation.

Approximately 14 feet separated Excavation #1 from Excavation #2, which was approximately 12 feet by 4½ feet in size. In Excavation #2, the 4-inch main's original external coating could not be examined because Laclede had removed much of it during their investigation and repairs (See Appendix B-5, Photograph 9). This, however, did facilitate ready inspection of the condition of the exterior pipe wall. The soil consistency of the excavation wall and floor were also observed and noted as resembling that of Excavation #1, described above.

Excavation #3 exposed the ¾-inch service to 416 Boyce; general observations were made of the repair as well as the soil consistency within the excavation (See Appendix B-5, Photograph 10). Laclede personnel stated that they did not believe the leak on the ¾-inch service to 416 Boyce contributed to the incident. Laclede explained their belief that the relatively small nature of the leak (a fizzer) would have been insufficient in magnitude to migrate over 65 feet to the 416 Boyce sewer lateral. In addition, the service line did not cross the dead end sewer main.

•416 Boyce Interior Observations•

The family member who had separated the sewer piping beneath the kitchen allowed access to 416 Boyce, and guided Staff and a Laclede claims representative from St. Louis through the structure, while describing his actions on March 25. The ground floors of 416 Boyce primarily consisted of a kitchen, bedroom, living room, and utility room, which was located at the back of the structure. Visible fire damage was primarily confined to the kitchen, along the east exterior wall. Kitchen cabinets and appliances, lining the length of this wall, exhibited varying degrees of light to moderate fire/heat damage (See Appendix B-2, Photograph 4).

Both the family member and Laclede representative believed the responding fire and police departments had moved the natural gas range unit and cut the approximate 18-inch square hole in the sub-floor, exposing the sewer drain stack beneath. This sewer drain stack consisted of, from the top-down, a 90° elbow fitting (90° fitting), a tee fitting, and an adapter attaching this piping assembly to the home's 4-inch sewer lateral that emerged from below ground. The 90° fitting connected the clothes washer drain line (approximately 8 feet in length and perpendicular to the east foundation wall), while the tee connection joined the kitchen drain line (approximately 7 feet in length and parallel to the east foundation wall), to the common piping assembly (See Appendix B-3, Photograph 6). The utility room, adjacent to the kitchen, housed the clothes washer and the planned installation of the shower unit.

Other rooms on the first floor exhibited signs of smoke and light heat damage. Upstairs, the area above the natural gas range and cabinets, a small opening had been made in the floor during overhaul efforts to vent and to extinguish any combustion that might exist between the first floor ceiling and second floor.

The basement area was accessed through the utility room and Staff was directed to the location of the sewer drain stack. The sewer drain stack was reached through an opening, approximately 2 feet by 2 feet in size and elevated approximately 4½ feet from the basement floor. The size of the opening tapered for 6-8 feet back to the sewer piping (See Appendix B-3, Photograph 6). At this location, a piece of cardboard had been placed on the soil after water immediately poured out of the clothes

washer drain line when it was disassembled. The family member indicated that the 90° fitting was removed to install the shower drain piping, and he thought it was "odd" to feel a "positive pressure" on his hand from air lightly emanating from the open sewer lateral after it was removed. He also described an odor after disassembling the 90° fitting, as that of "sewer gas."

In the immediate area of the sewer drain stack, the floor joist and sewer piping exhibited signs of light exposure to fire (See Appendix B-3, Photograph 6). The flash fire moved throughout this immediate area of the crawlspace and a sustained fire, "blowing like a torch", emanated from the sewer drain stack, as seen by the family member at the time of ignition. Immediate attempts were made by the family members to smother the sustained flame coming from the open sewer drain stack with a rag, but the rag soon caught fire, and the fire department was then promptly called. The family member was initially unaware of what caused the burst of flames in the crawlspace, or that an ensuing fire had started in the kitchen, until later discussing the event with the other relative who operated the natural gas range.

The Staff discovered, after further investigations, that some signs of natural gas odors might have been present prior to the incident. The Staff and the Laclede's claims representative were told that one of the residents of 416 Boyce had tried to suppress, with a cleaning agent, an "awful" odor coming from the kitchen sink. This odor became apparent whenever water drained from the kitchen sink or clothes washer. The relative explained that because the odor appeared to be coming from the sewer and did not portray the distinct odor of natural gas, a gas odor notification was not made to Laclede.

Further Staff Investigations

On April 3, 2000, Staff visited a Laclede office in St. Louis and spoke with the Laclede dispatcher that took the call from the Service Foreman on Saturday, March 25. The dispatcher indicated he had received written and hands-on training prior to performing the duties of a dispatcher. He also acknowledged he was trained on the Company's procedures specifically pertaining to notifying appropriate Company personnel of a reportable event. He explained that when an event is considered reportable, it is his responsibility to notify Laclede's Claims Department in St. Louis. When asked for key phrases or words that would prompt such a notification to the Claims Department, he responded that generally an event involving injuries, the media, or Company facilities that are "gas related" require appropriate notification. His accounts of the communications involving the event at 416 Boyce on March 25 were clear that no indications were made to him to describe the event as "gas related."

ANALYSIS

Company Actions Following Notification

Laclede's dispatching and initial responding Company serviceman conducted prompt response actions upon notification of the house fire at 416 Boyce on March 25, 2000. The initial responding serviceman's consultation with fire and police departments, his initial assessment of leak surveying the sewer, and prompt notification to the on-duty Service Foreman were also appropriate responding actions. The circumstances surrounding the serviceman's initial assessment warranted a Class 1 leak classification. A fire had occurred, and natural gas equal to or above the lower explosive limit (4.5% gas) found in a sanitary sewer warrant this leak classification and immediate corrective action should be taken (MoPSC Regulation 4 CSR 240-40.030(14)(C) noted on Page 7 of this report).

When the Service Foreman finished his initial conversation with the serviceman at the scene, he provided the Laclede dispatcher in St. Louis with an update of the event. He remembers his statements to the dispatcher were quite clear that the house fire at 416 Boyce was "possibly" gas-related. His assessment of the serviceman's description, which included the fire department's evaluation that the sewer pipe beneath the kitchen was possibly involved, and gas-in-air readings were taken from the sewer in front of 416 Boyce, did not conclude, in his opinion, that the incident could be confirmed "gas related." MoPSC Regulation 4 CSR 240-40.020(4)(A), referenced on Page 14 of this report, describes a reportable event as "where there is a suspicion ... the event may involve a release of gas involving the operator's actions or facilities ..." The event as described by the serviceman to the Service Foreman necessitated at least a notification to Laclede's Claims Department for them to evaluate and determine if notifying the Commission is warranted. The Staff believes based upon its investigation that the Service Foreman's assessment of the event appears to indicate a reluctance to have Laclede's Claims Department in St. Louis, who are qualified in damage assessment, notified.

By Company procedures, when an incident is gas related, the Laclede dispatcher is required to notify Laclede's Claims Department in St. Louis. Before ending his conversation with the Laclede dispatcher on March 25, the Service Foreman indicated to the dispatcher that he would be provided with an update. The Service Foreman did not call the dispatcher with an update, even after agreeing approximately 50 minutes later with the Director of Operations (Missouri Natural Gas division) that it was "pretty probable" the incident was gas related and indicated Laclede Claims Department should be notified. Because both the Service Foreman and Director

of Operations indicated they would appropriately notify Laclede's Claims Department, both believed the other would carryout the notification on March 25, but neither did. The Service Foreman understood that his responsibilities as coordinator included proper notification to inform dispatching and the Claims Department of a gas-related incident. The Service Foreman, therefore, failed to fulfill the notification responsibilities as a coordinator during the incident.

In association with the event on Saturday, March 25 at 416 Boyce, Laclede's Dispatching Department was provided a final call by the initial responding serviceman at 1:21 a.m. Sunday (March 26), verifying the completion of the job. Since no statements were transcribed of the event at 416 Boyce being gas related, the third dispatcher to receive information pertaining to the fire at 416 Boyce did not notify Laclede's Claims Department of the reportable incident.

The Claims Assistant for the MoNat service territory was given training and acknowledged his awareness of the MoPSC reporting requirements. The Claims Assistant and all other Company employees that were on-site during the March 25 incident were not trained or qualified to make a monetary assessment of the property damages, Company cost of maintenance and construction, and lost and unaccounted for gas. If personnel on-site made estimated assessments of damage, it would have been below the Company's more stringent internal reporting requirement of $5,000, otherwise, Laclede's Claims Department would have been notified (See **Laclede's Emergency Procedures and Training**, Page 13). Laclede's Claims Department personnel estimated the total damage at $20,000. The difference between these monetary estimates supports the Staff's belief that the Company did not have qualified personnel in damage assessment on-site. Staff believes that either personnel on-site were not qualified to make monetary assessments or Company procedures were not followed.

The Claims Department in St. Louis was not appropriately notified. Laclede's Claims Department notified Staff within two hours of its assessment, but if Company procedures allow for internal emergency notifications to be made days later to appropriate personnel, the Staff believes the procedures are inadequate and should be reviewed and appropriately revised. Personnel qualified in assessment of damages and authorized to properly notify the Commission should be, without hesitation, informed that an emergency situation exists even when there is a suspicion it is gas related, as indicated in MoPSC Regulation 4 CSR 240-40.020(4)(A).

Laclede personnel at the scene determined the incident was gas related at approximately 5:40 p.m. on March 25. At a minimum, three Laclede employees knew, beforehand, the MoPSC reporting requirements, and were aware of the responsibility to contact Laclede's Claims Department in the event of a gas-related incident, but all failed to verify that these Company

procedures were completed until Monday, March 27. The Staff believes the MoPSC minimum pipeline safety rules were not met, and the Company's emergency reporting procedures were not followed.

Laclede's Corrective Actions and Repairs

It was apparent a Class 1 leak, one requiring immediate corrective action, existed after the initial responding serviceman completed his initial investigation of the reported fire at 416 Boyce on March 25. The Service Foreman's statements to check the other homes in the area and to send additional help to the scene indicates that he and the serviceman realized immediate corrective actions were necessary. Immediate corrective actions must consist of providing safety to life and to protect property, as well as timeliness of proper venting and repairs of leaks. B*elow, in part, focuses on the amount of time natural gas was allowed to migrate within the sewer system after initial discovery by Laclede, and the timeliness of proper venting and repairs of leaks.*

By 4:45 p.m. on March 25, Laclede knew a gas odor was detected just prior to the fire, an individual had been physically exposed to a flash fire in a crawlspace beneath the kitchen, and a 26% gas reading was obtained from the sewer pipe beneath the kitchen. The police department had extinguished flames within the crawlspace beneath the kitchen. Also a 4.5 % gas reading was detected in the sewer manhole in front of 416 Boyce, and subsurface gas readings were detected near 416 Boyce. However, no attempts were made to excavate for the purpose of venting the natural gas to the atmosphere, or to request that mechanical digging equipment be sent to the site, until over 5 hours after initial Company arrival. Some venting actions were conducted. The sewer manhole in front of 416 Boyce was initially removed by the first responding serviceman, and air-jacking procedures were administered, but not until 2½ hours after discovery of the leaking and migrating natural gas. After these efforts were employed, the escaping natural gas continued to enter the sewer system and to migrate for 3¼ hours until excavations were initiated at approximately 10:30 p.m.

The natural gas entering the sewer system would also have found a path of least resistance to exit the sewer piping. Laclede could not have controlled the migrating natural gas within the sewer. The 7% gas reading, which is within the explosive range for natural gas (4.5% to 14.5%) and was nearing the optimum explosive limit (9% to 11%), detected one block away within the sewer main would verify this statement. The migrating natural gas was somewhat contained from venting to the atmosphere by the asphalt street and driveways, possibly disguising, in the absence of bar holes, its magnitude of migration. This is supported by the lower gas readings taken along

the street pavement edge and in the yards near 416 Boyce, while higher gas readings were taken in a valve box and bar holes within the street. There was an imminent danger of natural gas entering, and freely migrating through the sewer for a substantial distance that could have entered another structure. Also, the natural gas escaping and then migrating below a street, or driveway, could have entered a structure. This should have warranted concern to have mechanical digging equipment on-site and readily available.

Not until 8:35 p.m. Saturday night, over 4½ hours after initial arrival, did the six Laclede employees on-site request additional help, including a backhoe and a backhoe operator. At this time, natural gas readings were still detected within the sewer piping. Even with the Company's shop located approximately 10-12 blocks away, it took over 1 hour to contact a backhoe operator. Excavations began on Saturday night at approximately 10:30 p.m.

Laclede's lack of actions to make excavations to vent the natural gas to the atmosphere to mitigate its migration into the sewer, or to immediately request a backhoe and an operator, allowed the uncontrolled migration of natural gas within the sewer for over 5 hours after initial Company arrival. Actions to minimize potential imminent danger and migration of natural gas would have been to excavate at the location of the highest readings over the 4-inch main to allow venting of the natural gas to the atmosphere and attempt to find and eliminate the natural gas migration path into the sewer. The natural gas within the sewer should have been a priority, and the centralized subsurface natural gas readings in front of 416 Boyce gave indications where to begin initial excavations. Laclede personnel on-site, and the Service Foreman knew this at least 3½ hours prior to contacting a backhoe operator. In addition, Company efforts to employ air-jacking procedures 2½ hours after arriving, in the Staff's opinion, was delayed and was not effective in preventing the migrating natural gas from entering the sewer.

Natural gas readings in the sewer pipe beneath the kitchen dropped from 26% to 20% after air-jacking procedures were employed, but natural gas readings near the optimum explosive limit remained in the sewer one block away. Not until over 6 hours after responding to the scene and after initial excavations were made did the natural gas readings in the sewer pipe beneath the kitchen drop to 1%.

Upon detection of the first corrosion leak on Monday, March 27, Laclede displayed its capabilities to promptly investigate, excavate and repair a leak. These actions were completed within 1 hour 15 minutes.

The Escape, Migration, and Ignition of Natural Gas

With 3 corrosion holes on the 4-inch main, natural gas was able to escape from the confines of the pipe and begin to migrate. Considering the characteristics of corrosion, the corrosion holes did not exist instantaneously, but had developed over an unknown period of time. Therefore, it is likely that natural gas had been escaping and possibly migrating for some time prior to the incident. The pavement and soil compaction most likely restricted some upward migration of the natural gas, causing the natural gas to find a path with less resistance. The relatively close proximity of the three corrosion holes on the 4-inch main with the 416 Boyce sewer lateral connection to the sewer main, which dead-ended in front of 416 Boyce, allowed natural gas to freely migrate through the sewer piping upon entering.

Natural gas migrated through the 416 Boyce sewer lateral, but was halted inside the house sewer piping at each water trap/P-trap, which are installed for the purpose of preventing sewer odors and/or gas from venting openly into the home. Coincidently, family members indicated a strong odor had been coming from the kitchen sink when the clothes washer or kitchen sink would drain. This most likely occurred when water drained and percolated through the water traps, allowing small air bubbles of odors containing natural gas to pass up from the sewer lateral and through the kitchen sink drain. These were the only two house sewer drainpipes connected to the sewer drain stack located beneath the kitchen.

Once the family member separated the house sewer piping beneath the kitchen area, the migrating natural gas was able to vent within the crawlspace. Natural gas began to accumulate within the crawlspace area, migrating upward through the crevices of the structure and into the kitchen. Natural gas accumulated to an explosive mixture during the time taken by the family member to find a piece of cardboard to lay on the wet soil after separating the house sewer piping. Two family members noticing a natural gas odor in the kitchen, most likely ignited the accumulating natural gas when they operated the range.

Corrosion Failure of the 4-inch main

For being in operation since the 1930's, it is not uncommon for a pipeline to be in relatively good condition, including its external coating. Minimizing damages to the external coating during installation or repairs, and administering prudent cathodic protection practices are key factors to the longevity of a steel pipeline's service life. Over the years, based upon Company records, the 4-inch main in front of 416 Boyce has not exhibited a problematic service life.

Previous repair records and the soil condition examined within the Excavations #1 and #2, however, give some indication that the 4-inch main was originally backfilled with material capable of scratching or gouging its external coating. A scratched or gouged external coating can create corrosion cells over time. The March 1946 Company leak repair record, identified in the **Previous Company Actions** section of this report, noted a large rock found laying on the ¾-inch service. It would not be unrealistic to assume that similar backfill conditions exist in other areas along the 4-inch main.

Laclede has taken actions to ensure that adequate levels of cathodic protection are applied and monitored. Previous cathodic protection surveys within the 400 Block of Boyce Avenue have shown above adequate levels of cathodic protection. A cathodic protection reading of –1.13 volts that was indicated on the 4-inch main almost in front of 416 Boyce at 415 Boyce, may not have indicated active corrosion existing under the street, and most likely did not give a true potential reading of the cathodic protection applied at the main location. It is unclear from the Company records exactly how the cathodic protection readings were taken. Isolated corrosion cells on steel piping located beneath pavement, in addition to the rocky soil conditions, may be difficult to detect.

Corrosion is a natural phenomenon and it is not uncommon for it to occur. Implementations of appropriate cathodic protection practices are the best methods of ensuring corrosion control. As mentioned in the **Previous Company Actions** section of this report, Company records have shown the relatively recent installation of test stations and anodes on the 4-inch main. This gives some indication that the Company has been monitoring the 4-inch main for cathodic protection levels and has taken corrective action based upon the results of its monitoring. Staff believes further Company investigations of its cathodic protection survey methods, i.e., remote readings out of the influence of anodes, a history review of anodes placed on the main, and possibly a close interval survey over the main, are warranted based upon the investigation and evidence of this incident investigation.

CONCLUSIONS

1. At approximately 3:15 p.m., CST, Saturday, March 25, 2000, a natural gas ignition and subsequent fire occurred at 416 Boyce Avenue in Farmington, Missouri.

2. One individual suffered burns to his face and right arm from the initial flash fire. He refused initial medical treatment. On March 29, 2000, the man went to a medical clinic in Columbia, Missouri, where he was treated for 2nd degree burns and released.

3. The residence at 416 Boyce exhibited smoke and heat-related damage as a result of the ensuing fire. Fire and heat damage was primarily contained within the kitchen of the residence. The total monetary value of structural and material damage sustained as a result of the incident was estimated by Laclede to be approximately $20,000.

4. The probable cause of the incident was the ignition of natural gas that had accumulated within the residence at 416 Boyce. The natural gas originated from three corrosion holes in a 4-inch diameter, coated and cathodically protected steel natural gas main located beneath Boyce Avenue. The corrosion holes were within 27 feet of a sewer main, near the connection of the 416 Boyce sewer lateral. Escaping natural gas migrated to the sewer main and then to the connecting sewer lateral that emerged within a crawlspace area beneath the kitchen in 416 Boyce. Family members inside the residence separated the house sewer piping to install a shower unit, allowing the migrating natural gas to accumulate within the structure. The probable source of unintentional ignition was a natural gas range that was operated because it was believed to be releasing natural gas into the kitchen.

5. Laclede promptly responded to a Farmington Fire Department notification of a fire at 416 Boyce. The initial responding serviceman's assessment of the event and subsequent leak investigations determined a Class 1 leak existed, one requiring immediate corrective actions.

6. Within 2 hours from the Company's initial arrival to the scene, several Laclede personnel were contacted, with six employees responding and arriving on-site. Within this same time period, Laclede knew the following information:

   - A natural gas odor was detected just prior to the fire;

- An individual was physically exposed to a flash fire;
- A 26% gas reading was taken from the sewer pipe beneath the kitchen of 416 Boyce;
- The police department had extinguished flames within the crawlspace beneath the kitchen;
- A 4.5% gas reading was detected in the sewer manhole in front of 416 Boyce; and
- Subsurface gas readings were detected near the 416 Boyce premises.

Provided with this information, a Service Foreman, who is responsible for notifying appropriate Company personnel of a reportable incident, described the event as "possibly" gas related.

Even describing the event as "possibly" gas related, the Service Foreman must have had a suspicion that the event may have involved a release of natural gas from Laclede's facilities.

7. Within 2 hours of the Company's arrival at the scene on March 25, a Laclede dispatcher was provided an update of the incident. He was told the event was "possibly" gas related, but not confirmed. If the event was identified as gas related, the Laclede dispatcher would be required to contact Laclede's Claims Department in St. Louis. The Claims Department is required to notify the Commission of reportable natural gas incidents. On March 27, Laclede's Claims Department was contacted and notified the Commission the same day.

8. The Staff believes that Laclede violated 4 CSR 240-40.020(4)(A) which states: "Within two (2) hours following discovery by the operator MoPSC Regulation 4 CSR 240-40.020(4)(A), or as soon thereafter as practicable ... each gas operator shall notify designated commission personnel by telephone of the following events within areas served by the operator:

    1. An event that involves a release of gas involving the operator's actions or facilities, or where there is a *suspicion* by the operator that the event may involve a release of gas involving the operator's actions or facilities, and involves –

A. A death;
B. A personal injury involving medical care administered in an emergency room or health care facility, whether inpatient or outpatient, beyond initial treatment and prompt release after evaluation by a health care professional; or
C. Estimated property damage, including cost of gas lost, to the gas operator or others, or both, of ten thousand dollars ($10,000) or more; or

2. An event that is significant, in the judgment of the operator, even though it did not meet the criteria of paragraph (4)(A)1."

The Service Foreman and Director of Operations had agreed within 2 hours after the Company's arrival to the incident that the event was gas-related and indicated Laclede's Claims Department should be contacted. Having made this determination, Company procedures requiring notification to the Claims Department were not followed. Subsequently, the Claims Department was not notified until 2 days later on March 27, 2000. Missouri Natural's internal reporting procedures require notification to Laclede's Claims Department if damages exceed $5,000.

9. Natural gas was allowed to migrate freely within the sewer system for over 5½ hours before initial excavations were made to expose a corrosion leak on the 4-inch main. This migrating natural gas could have possibly entered other structures via dry traps, or other disconnected sewer piping. However, Laclede personnel did not take prompt actions to fully vent or terminate the flow of natural gas in a timely manner. The magnitude and extent of migration of the escaping natural gas required immediate corrective action.

10. Laclede personnel on-site conducted investigations and leak detection surveys for over 4 hours before requesting a backhoe and backhoe operator to the incident scene. A backhoe operator was then not contacted until over 1 hour later. A backhoe or other mechanical digging equipment, capable of excavating in the street over the 4-inch natural gas main, did not arrive to the scene for over 5 hours from the Company's initial arrival to the scene. Gas-in-air readings above the lower explosive limit of natural gas remained in the sewer during this time period. Under these conditions, natural gas is in imminent danger of entering the surrounding buildings.

11. The Staff believes Laclede's actions subsequent to the natural gas ignition at 416 Boyce violated MoPSC Regulation 4 CSR 240-40.030(14)(C), which states that: "Class 1 leak is a gas leak which, due to its location and/or magnitude, constitutes an immediate hazard to a building and/or the general public. It shall require immediate corrective action which shall provide for public safety and protect property." Laclede conducted preventive actions by opening manhole covers to the sewer, but natural gas accumulations above the flammable limits of natural gas existed in the sewer system throughout the evening. Laclede conducted other preventive actions by administering air-jacking procedures, 2½ hours after their initial arrival, in the area of the incident. However, Laclede failed to, simultaneously and in a timely manner, take additional corrective actions when after these venting actions were taken, sustained gas readings remained in the sewer.

RECOMMENDATIONS

1. The Staff recommends that Laclede review and revise as necessary its procedures and processes of appropriate notification to designated Company personnel who are responsible for contacting the Commission of a reportable incident. These procedures and policies should stipulate that even if there is a suspicion that an event is reportable, appropriate Company personnel should be provided the opportunity to make the distinction. Refresher training should be provided to all personnel, not just those involved with this incident, to make sure any Company personnel responsible for reporting an emergency situation is capable of making decisive, prompt decisions.

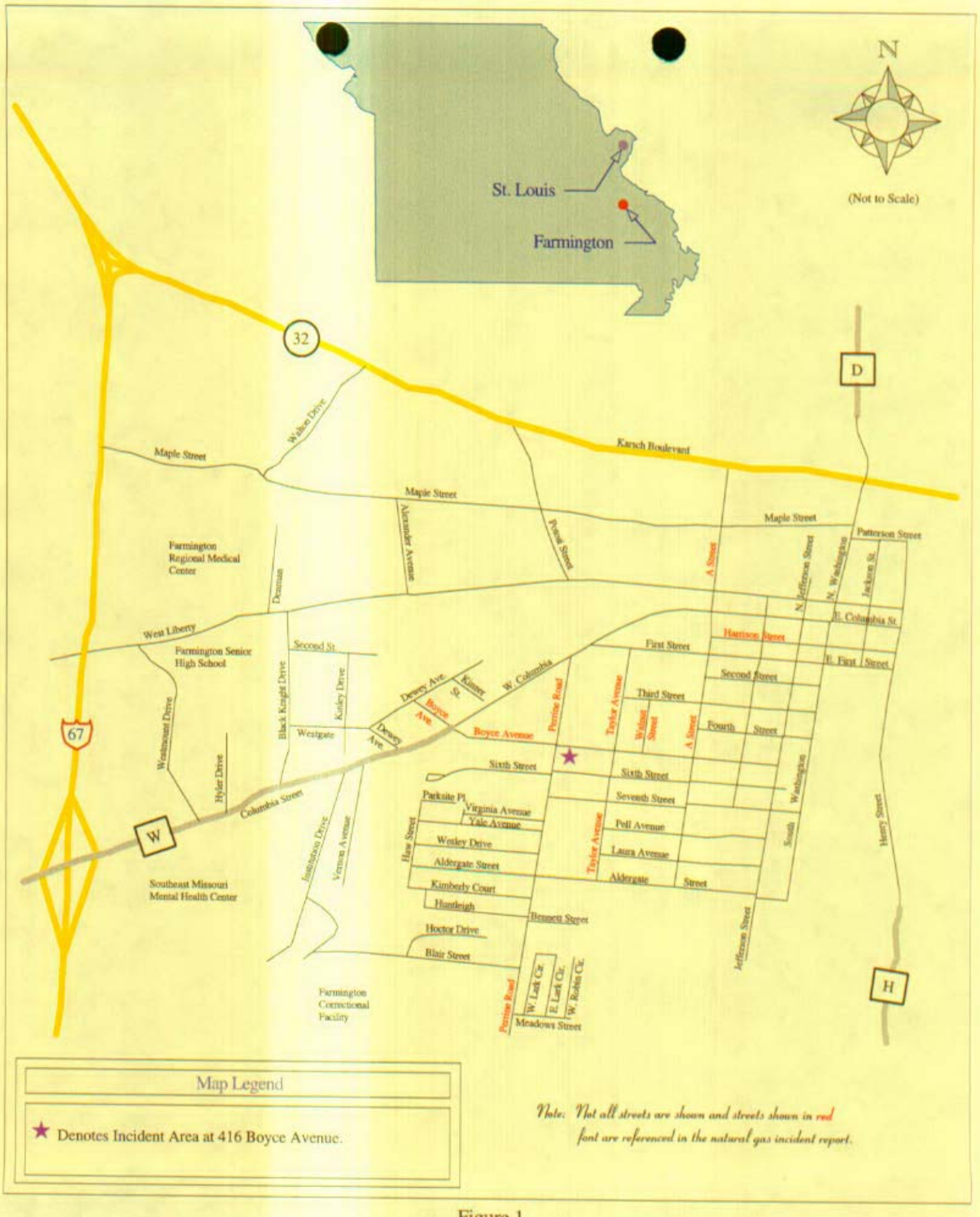
2. The Staff recommends that Laclede review and revise as necessary its procedures for responding to, and acting upon a gas leak that is beyond routine action. Specifically, the early recognition of the hazards associated with the magnitude and extent of migration of escaping natural gas, and the complete venting and termination of escaping natural gas must be initiated in a timely manner that protects life and property. Procedures should include the necessity to have mechanical digging equipment readily accessible while working an emergency situation. Refresher training should be provided to all personnel, not just those involved with this incident, who would have the opportunity to respond to an emergency situation, in order that prompt actions are taken to make the area safe.

3. The Staff recommends that Laclede evaluate and revise as necessary its training methods to instruct personnel in the proper emergency response procedures to include the early recognition of a hazard, working in close proximity to a potentially hazardous site, and the fastest, safest and most efficient method for terminating the flow of natural gas in an emergency. Natural gas incidents, while unfortunate in occurrence, provide examples where lessons can be learned. Therefore, the circumstances of, and the problems encountered, in the March 25 incident should be incorporated into the training.

4. The Staff recommends that Laclede be directed to file a response regarding each of the recommendations contained in this Case within 60 days of the filing of this report.

5. The Staff recommends that the Office of General Counsel cause a complaint to be filed with the Commission regarding the violations noted in this Gas Incident Report.

APPENDIX A
(Figures)



Map Legend

★ Denotes Incident Area at 416 Boyce Avenue.

Note: Not all streets are shown and streets shown in red font are referenced in the natural gas incident report.

Figure 1
Overall View of 416 Boyce Avenue Incident Location
Appendix A-1

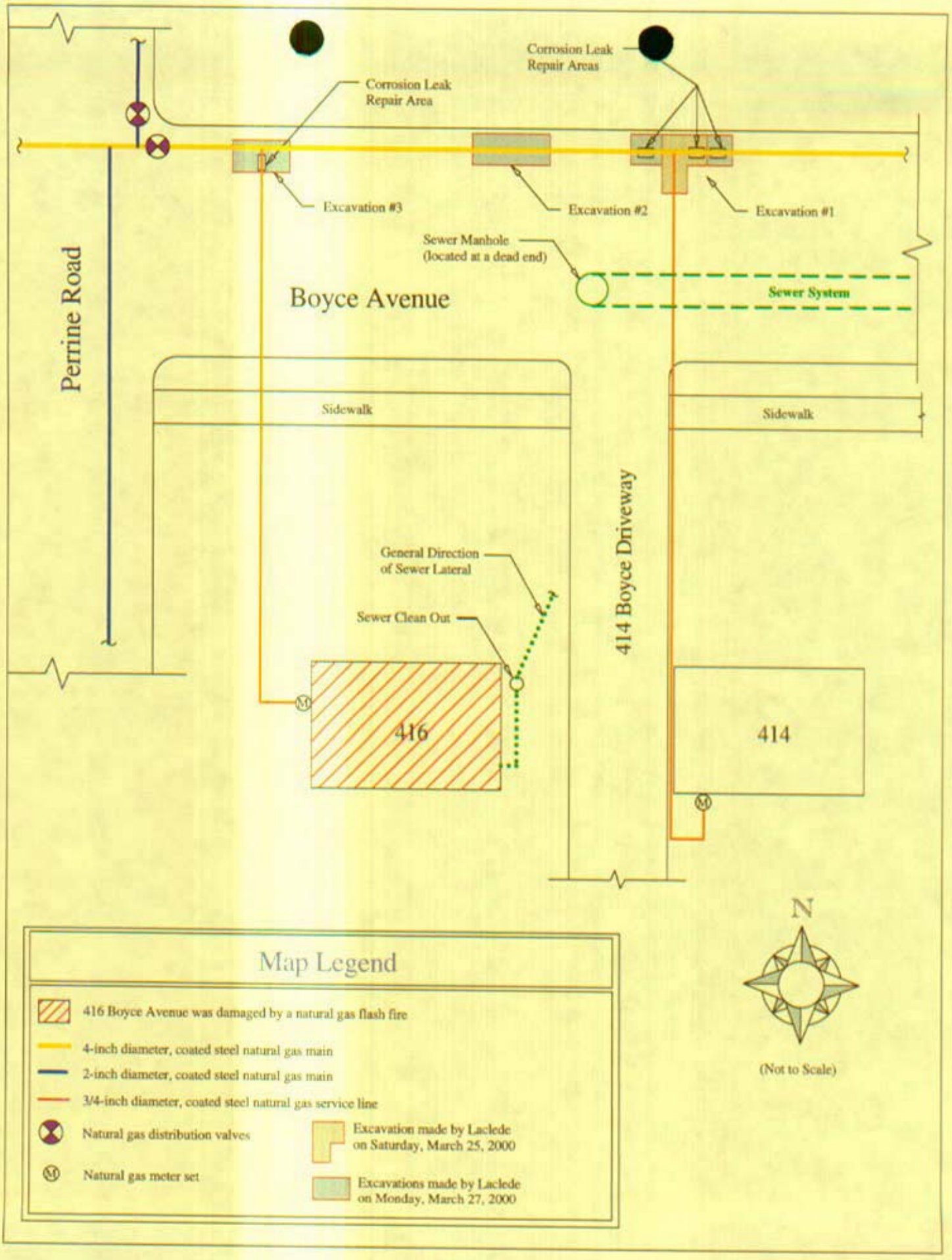
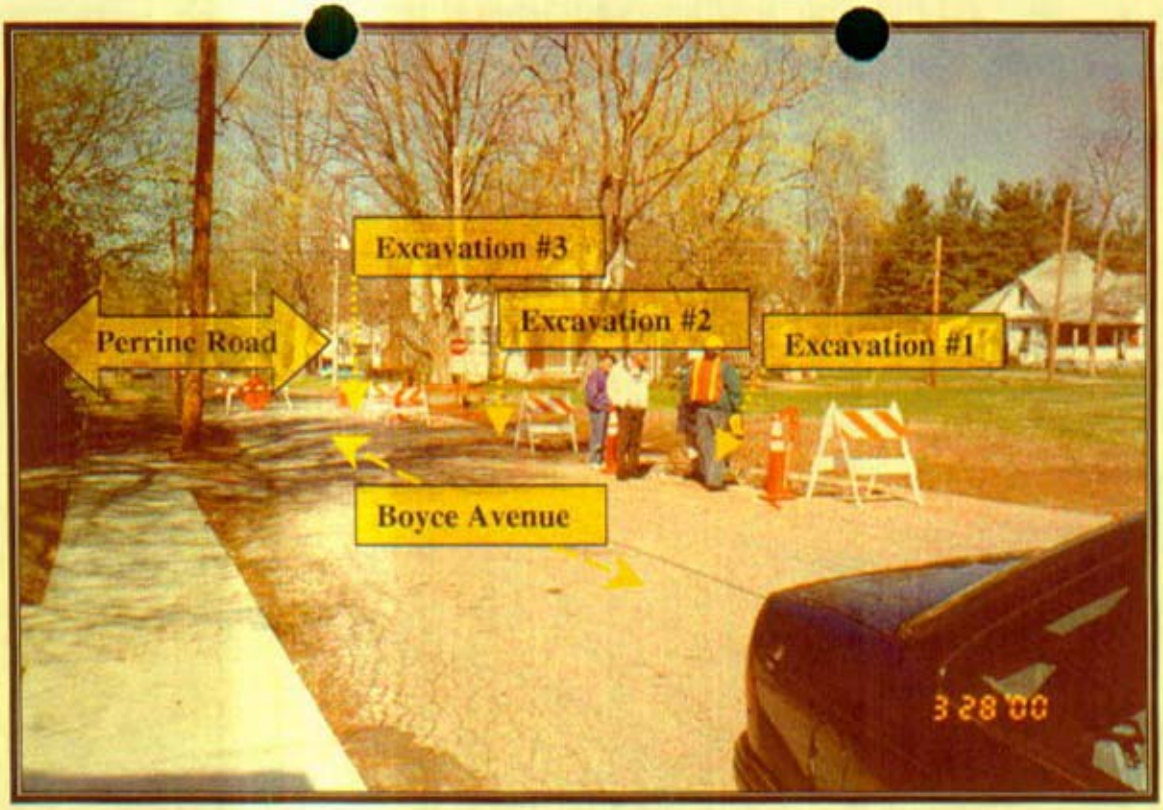
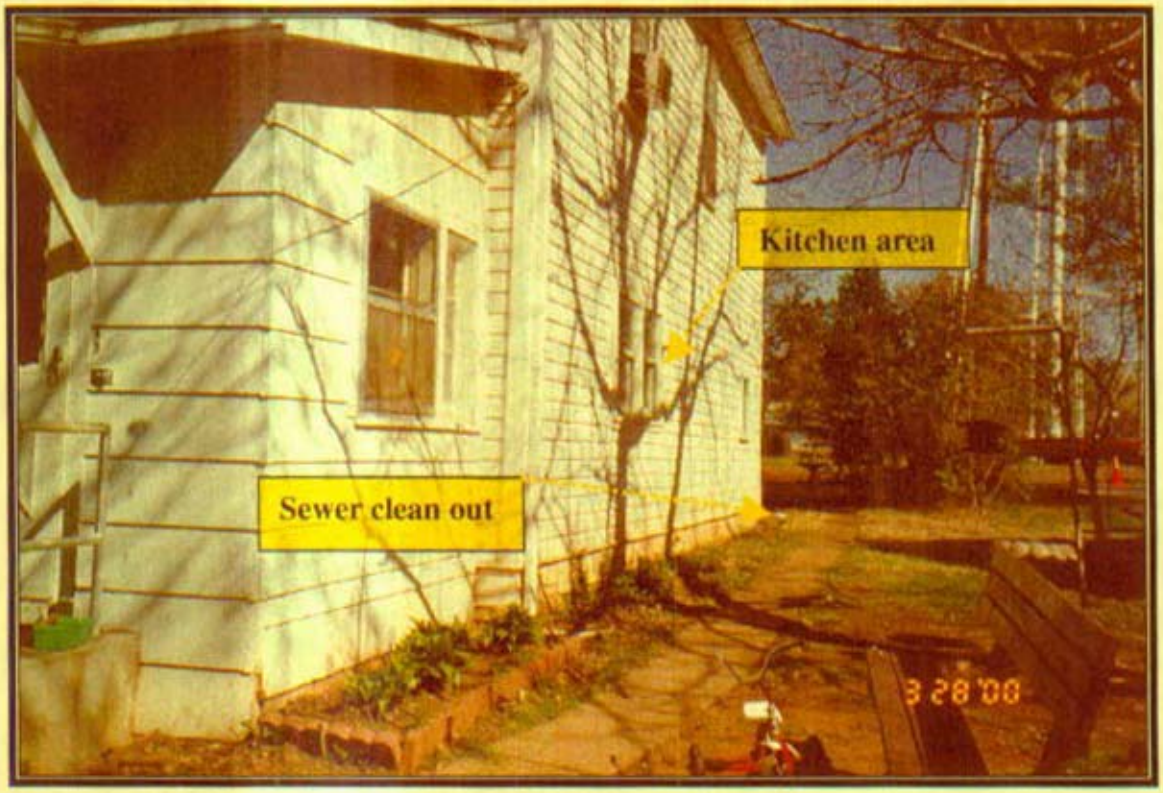


Figure 2
Plan View of 416 Boyce Avenue Incident Area
Appendix A-2

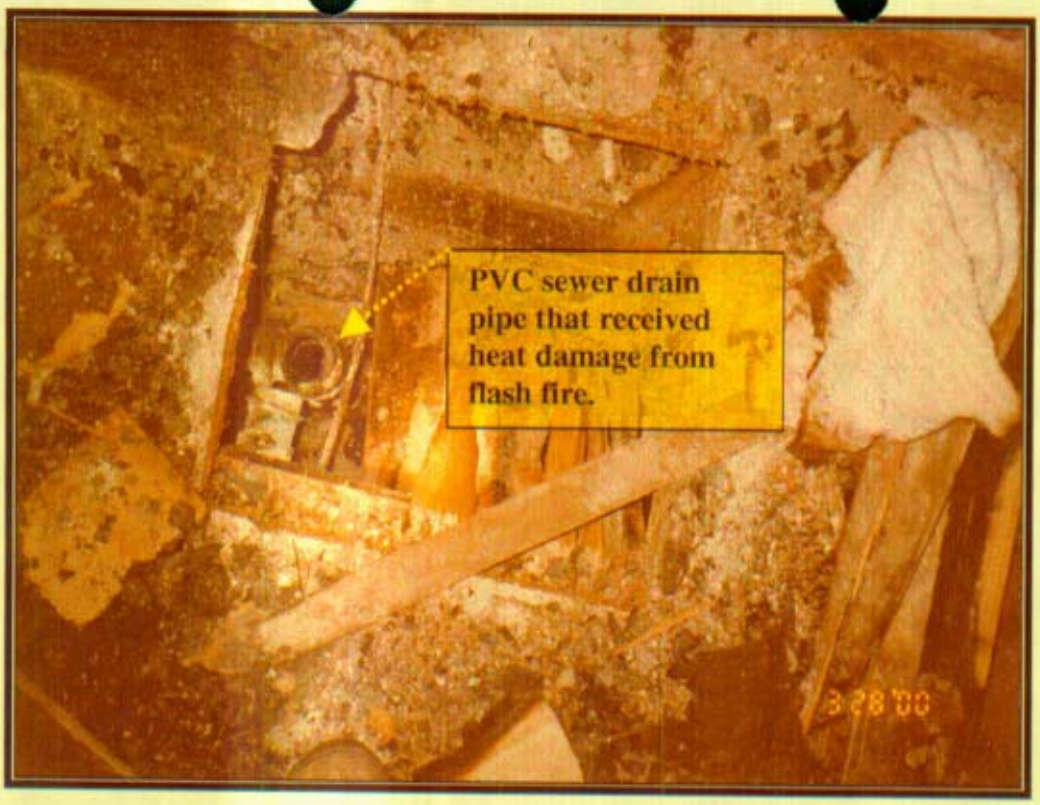
APPENDIX B
(Photographs)



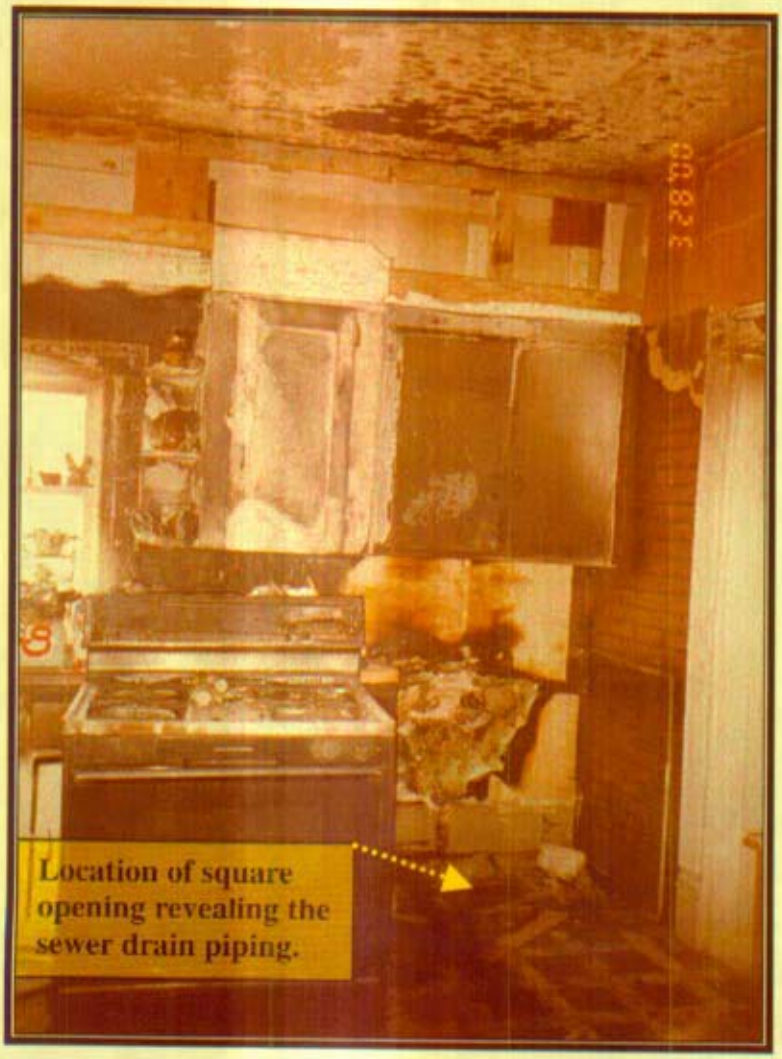
Photograph 1 Looking northwest at excavations made by Laclede personnel.



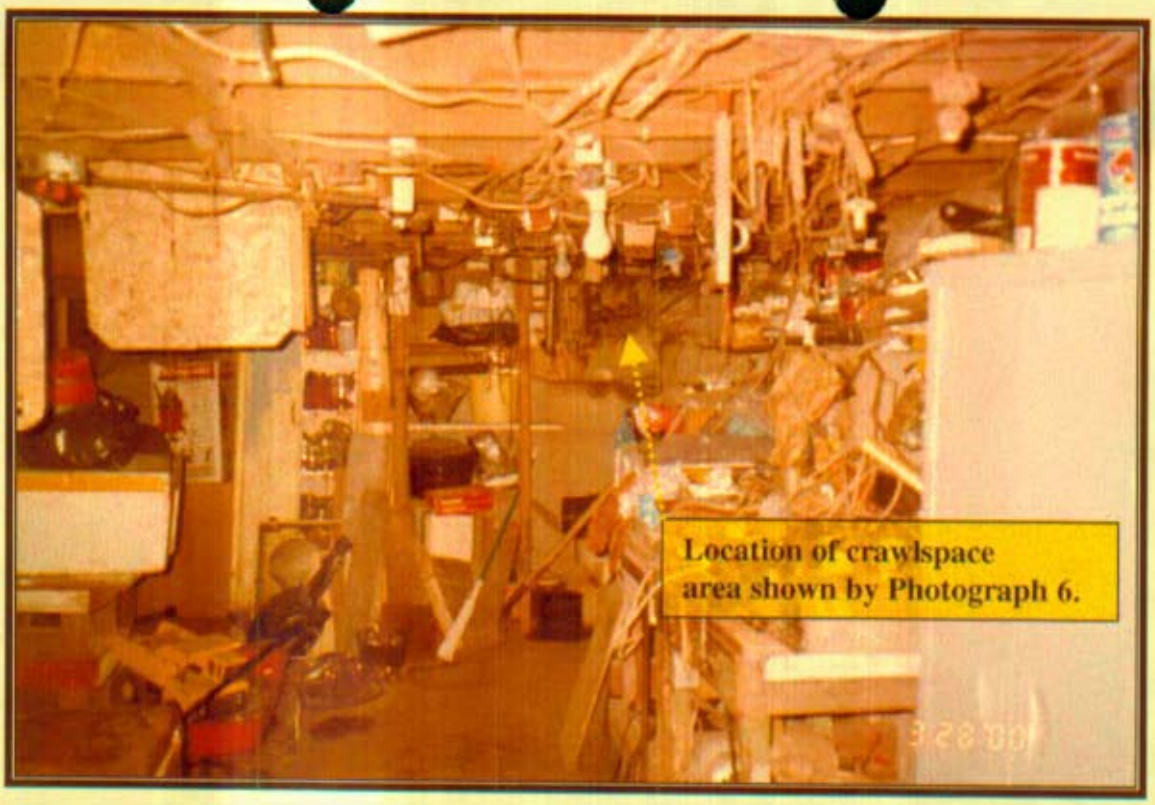
Photograph 2 View of the southeast corner of 416 Boyce Avenue. Note the sewer cleanout location in the background.



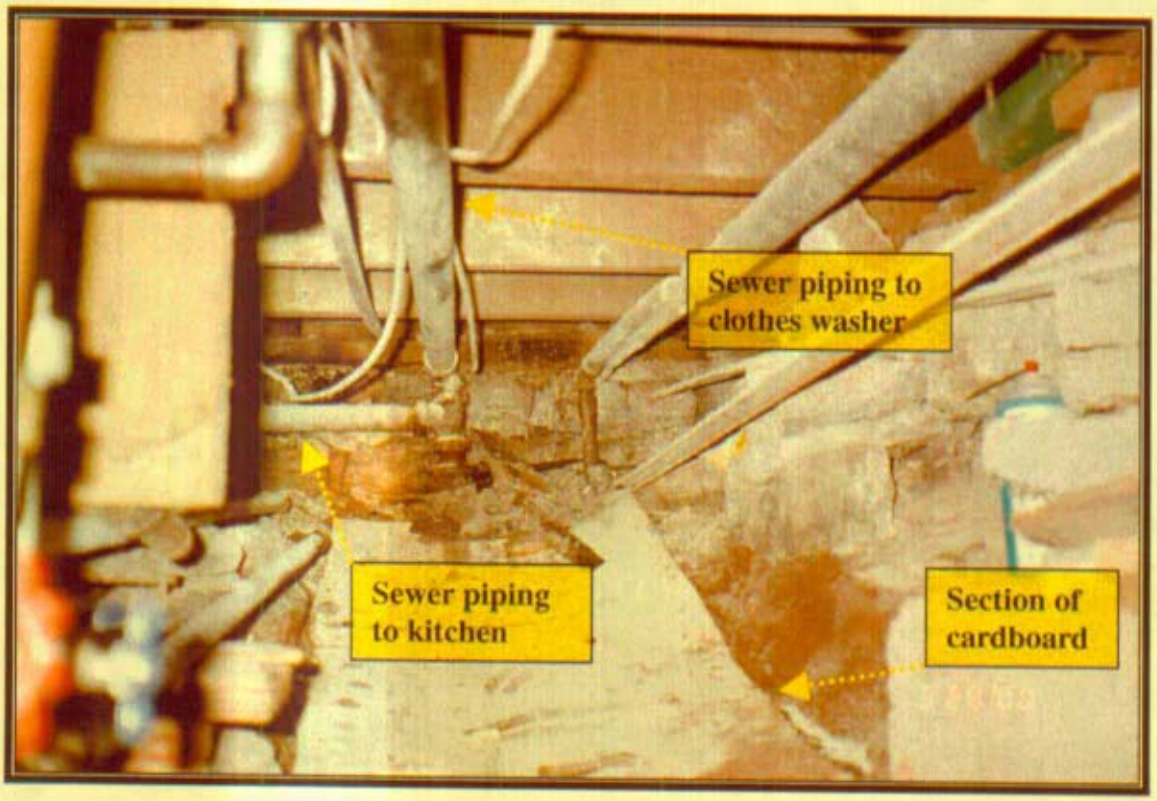
Photograph 3 Looking down through a square opening made in the kitchen floor of 416 Boyce Avenue. Gas-in-air readings of 26% were taken after the incident from the sewer drain piping.



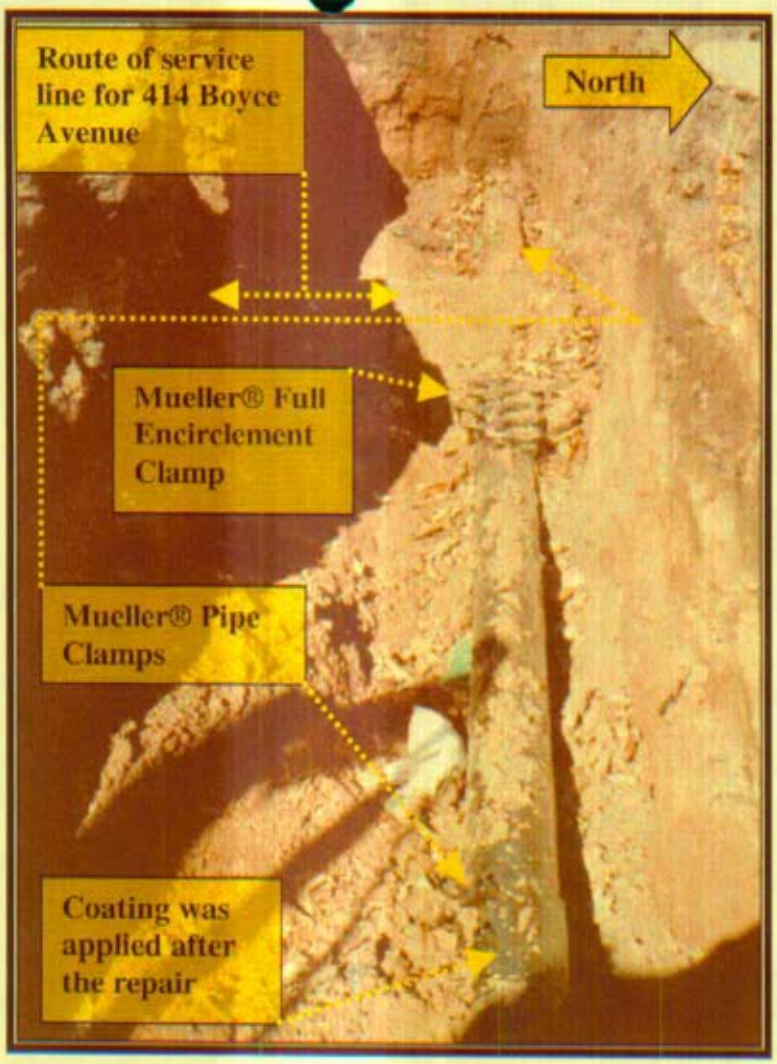
Photograph 4 View of the kitchen area for 416 Boyce Avenue. Observe the heat damage to the ceiling, cabinets, and wall areas.



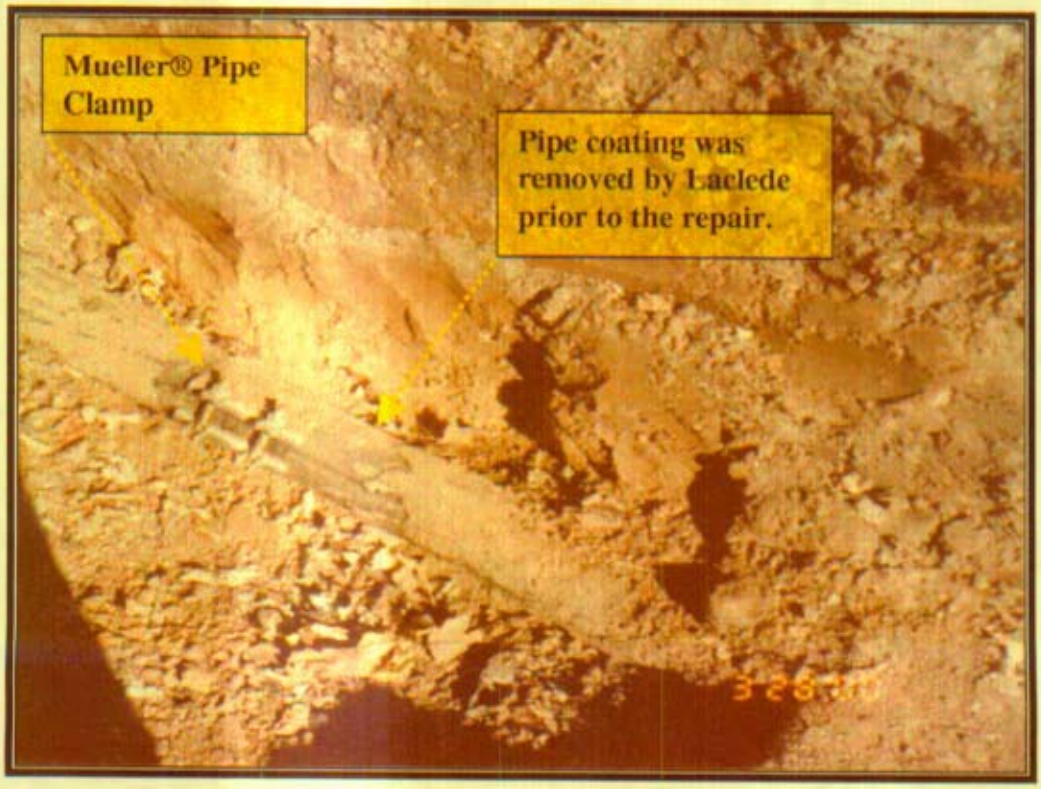
Photograph 5 View of the half-basement of 416 Boyce Avenue, looking east.



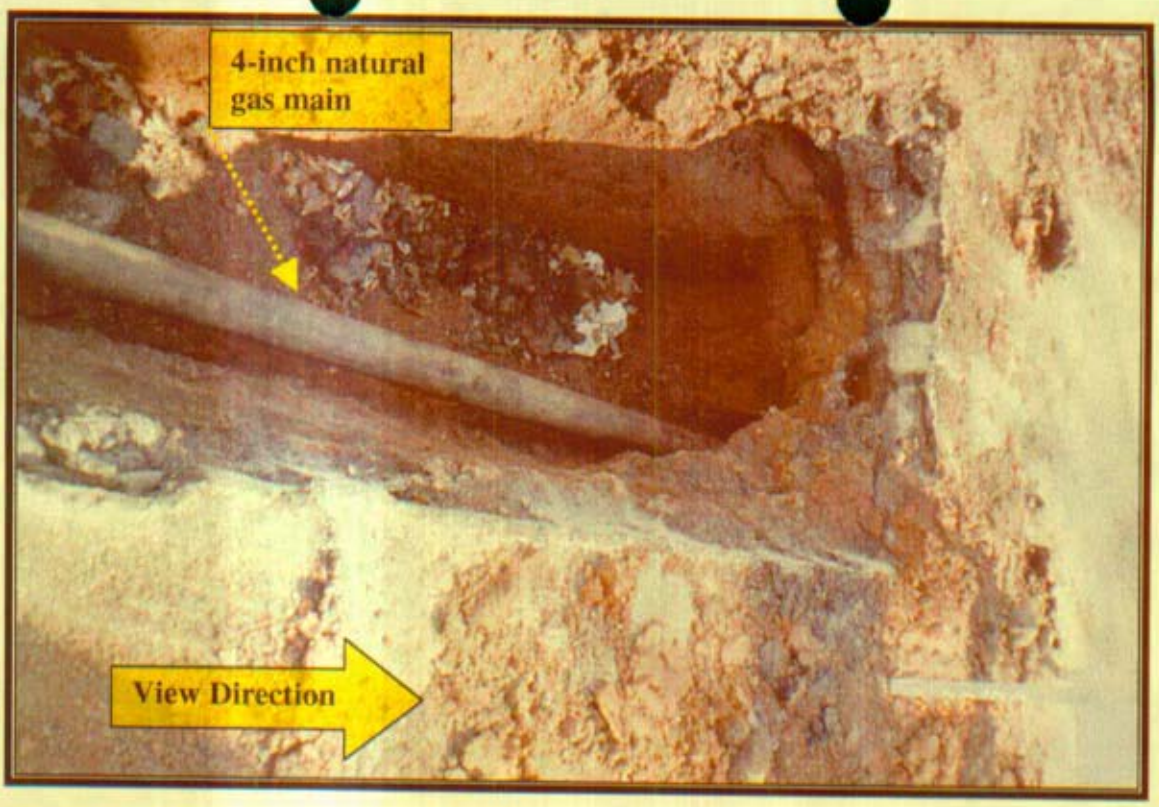
Photograph 6 View looking east in the crawlspace for 416 Boyce Avenue. Observe the sewer drain piping to the kitchen and clothes washer. A relative of the residents of 416 Boyce Avenue was positioned on the cardboard at the time of the natural gas ignition.



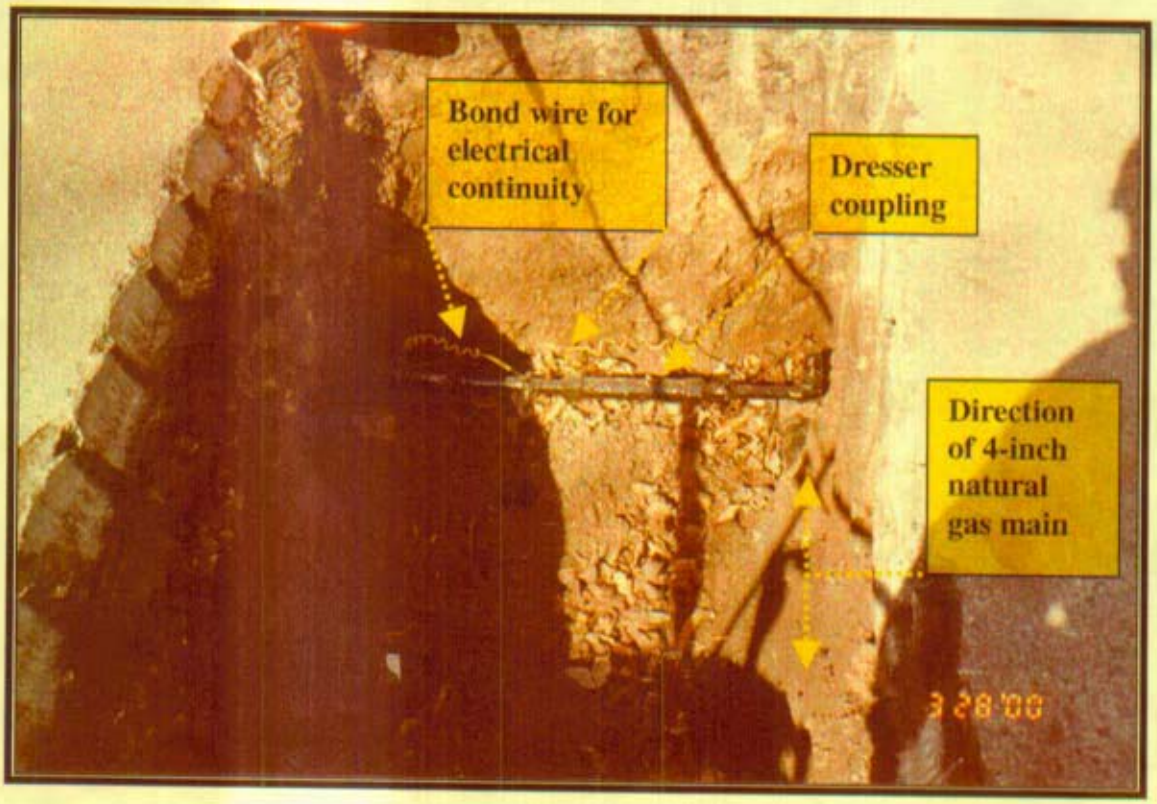
Photograph 7 Looking west inside of Excavation #1 at the three repaired corrosion leaks on the 4-inch natural gas main. The service line for 414 Boyce Avenue was not exposed. The excavation over the 414 Boyce Avenue service line and full encirclement clamp was made on March 25, 2000. The excavation was elongated, both east and west directions, on March 27, 2000.



Photograph 8 View of the repair clamp as shown in the upper right-hand corner of Photograph 7. This section of main had a dime-sized corrosion hole in the bottom-half of the pipe.



Photograph 9 Looking east inside of Excavation #2. The pipe coating was removed to determine the extent of any further active corrosion. No corrosion leaks were observed in this excavation.



Photograph 10 Looking west inside of Excavation #3. Observe the repaired ¾-inch diameter, coated steel natural gas service line that serves 416 Boyce Avenue. The small corrosion leak found at this location was not believed to have contributed to the incident.