Missouri Public Service Commission

Gas Incident Report

Missouri Gas Energy
Case No. GS-2003-0468

3441 Chestnut Avenue
Kansas City, Missouri
March 9, 2003

Gas Safety / Engineering Section ... Energy Department ... Utility Operations Division
September, 2003 Jefferson City, Missouri

Exhibit A

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SYNOPSIS

On Sunday, March 9, 2003, natural gas accumulated within 3441 Chestnut Avenue in Kansas City, Missouri, before being ignited at approximately 10:30 a.m., Central Standard Time (CST). The residential home, 3441 Chestnut Avenue, sustained severe fire damage and was considered a total loss. At the time of the ignition, three young girls were inside the structure but were able to exit without injury. A Missouri Gas Energy (MGE or Company) serviceman who had responded to an odor call from an occupant at 3433 Chestnut Avenue, just two homes north of the explosion, assisted the young girls out of their home and to a safe location. There were no injuries or fatalities resulting from the incident.

MGE, a Division of Southern Union Company, provides natural gas service in Kansas City, Missouri. A 6-inch diameter cast iron natural gas main that was installed in 1908 lies in a north-south direction beneath Chestnut Avenue. At the time of the incident, the 6-inch diameter cast iron main was operating at approximately 30-inches water column (IWC), where one pound per square-inch gauge (psig) equals approximately 27.71 IWC. The maximum allowable operating pressure for the 6-inch diameter pipeline involved in the incident is approximately 61 IWC, or approximately 2.2 psig.

The Missouri Public Service Commission's (MoPSC or Commission) Energy Department – Safety/Engineering Staff (Staff) has determined the incident on March 9, 2003, resulted from a circumferential crack in a MGE 6-inch diameter cast iron natural gas main, which allowed natural gas to escape and permeate the surrounding soil. Staff believes evidence supports that natural gas escaping from the cracked cast iron main most likely found its way into the sewer lateral, entered through a drain of 3441 Chestnut Avenue, accumulated to a flammable atmosphere, and was ignited by an unidentified ignition source.

When initially responding to the odor notification at 3433 Chestnut Avenue, a MGE serviceman obtained a 20 percent gas-in-air reading upon entering 3433 Chestnut Avenue. The Company employee also detected equivalent percentages of gas in the home's basement floor drain. Only after continuing leak investigations in the basement, turning the gas meter "off", and then hearing the explosion did the serviceman evacuate the premises of 3433 Chestnut Avenue.

Disturbed soil conditions were present beneath the area of the cracked cast iron main, providing evidence of undermining and/or inadequate supporting backfill for this 6-inch diameter cast iron main lying beneath Chestnut Avenue. It is believed that the undermining and denseness of backfill created insufficient support during sewer excavation activities and directly contributed to the break in the cast iron main. At this time, Staff believes that further evidence is needed to make accurate recommendations to MGE that properly address: Company inspections conducted during the sewer excavations along Chestnut Avenue; liaisons with other utility operators;

undermining and supporting of cast iron pipelines during excavation; proper backfill practices; and overall effectiveness of MGE's cast iron replacement program as it pertains to third party excavations occurring near MGE's cast iron mains and the replacement schedules for those particular pipelines.

At this time, evidence gathered during the Staff's investigation in to this incident does warrant recommendations to MGE that address the following of Company procedures, specifically, those procedures pertaining to emergency conditions.

Based upon evidence collected during its investigation, the Staff has determined that sufficient evidence exists to conclude that MGE violated Missouri Public Service Commission (MoPSC) Regulations 4 CSR 240-40.030(12)(C), which states that each operator shall prepare and follow for each pipeline, a manual of written procedures for conducting operations and maintenance activities and for emergency response. The Staff does not believe that the probable violation of this MoPSC pipeline safety regulation contributed to the incident.

At this time, five recommendations are being made as a result of the Staff's investigation. One recommendation pertains to the probable violation of MoPSC pipeline safety regulations that occurred as a result of an MGE employee's actions. Another recommendation requests a six-month period to allow for further Staff investigations into the excavations that occurred prior to the incident at the location of the break in the 6-inch cast iron main and MGE's overall cast iron main replacement program. All of Staff's recommendations are addressed in detail in the **RECOMMENDATIONS** section of this report.

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 10:25 a.m., CST (all times in this report are CST), on Sunday, March 9, 2003, an MGE serviceman arrived at 3433 Chestnut Avenue (3433 Chestnut) in response to a customer gas odor notification. Within minutes of MGE's arrival and while conducting a leak investigation inside 3433 Chestnut, an explosion and subsequent fire occurred two homes away, at 3441 Chestnut Avenue (3441 Chestnut) in Kansas City, Missouri.

Personal Injuries

At the time of ignition, three young girls were inside 3441 Chestnut, the oldest girl was reported being 13 years-of-age. They were playing upstairs when the explosion occurred but were able to exit the damaged structure to a safe location without suffering any reported injuries. Within minutes after the three girls exited the structure, fire department personnel arrived on the scene, entered 3441 Chestnut, and advanced to the home's upstairs. At about that time, the stairway of the residence collapsed due to the fire, trapping the three firemen upstairs. A hole was made in the roof, allowing the firemen to escape and jump to the adjacent home's roof. There were no reported injuries resulting from the firemen's efforts. There were no reported injuries or fatalities as a result of the incident.

Property Damage

As a result of the natural gas explosion and subsequent fire, the 3441 Chestnut dwelling was left uninhabitable and as a complete loss of structural and personal property. To the north and adjacent to 3441 Chestnut is the residence of 3437 Chestnut, which consequentially suffered minor damage from the extraction of debris and the collapse of the 3441 Chestnut residence (Appendix B-1, Photograph 1). MGE reported estimated property damage of $50,000.

Site Description

The 3400 block of Chestnut Avenue is located in Kansas City, Missouri, southeast of downtown Kansas City (See Appendix A-1, Figure 1). The section of Chestnut Avenue where the incident

occurred is situated between E. 35th Street (to the south) and E. 34th Street (to the north) and parallels Prospect Avenue located two blocks away to the east. Early 1900's vintage residential homes populate both sides of Chestnut Avenue, which is a one-way southbound street. Large two-story (plus) homes on grade with the street are situated approximately 40 feet west of the west curb line of Chestnut Avenue, while the homes east of the east curb line are situated on an elevated grade with respect to the street. The homes lying east of Chestnut Avenue are two-story structures of similar construction, each separated from the next by a distance of approximately 7 to 10 feet. The two-story structure of 3441 Chestnut was comprised of a wood frame atop a stone-block foundation with an exterior consisting of brick façade and asbestos siding covered by a shingled roof.

At the location of the incident, utility mains for water, sewer, and natural gas all lie beneath Chestnut Avenue. The water main is approximately 5 feet east of the west curb line; the cast iron natural gas main is approximately 8 feet 7 inches west of the east curb line; and the sewer main is approximately centered between east and west curb lines of Chestnut Avenue.

Meteorological Data

The Kansas City Airport recorded a high temperature of 29 degrees Fahrenheit (°F) and a low temperature of 10.4 °F on March 9, 2003. On this day, there was no amount of precipitation recorded and the average wind speed was 10.0 miles per hour (mph).

Natural Gas System

MGE, a Division of Southern Union Company, provides natural gas service in Kansas City, Missouri. Within a one-block radius of the incident site, cast iron mains of 6-inch diameter and 12-inch diameter, with installation dates going back to the early 1900's (1907 to 1912), deliver natural gas from their locations beneath the city streets to each customer service line. During the installation of the cast iron mains, the material of choice for the natural gas service lines was bare steel, but since then MGE has been systematically replacing bare-steel services with polyethylene (PE) pipe.

At the location of the incident, lying beneath the 3400 block of Chestnut Avenue at approximately 42 inches is a 6-inch diameter cast iron main that was installed in 1908 and serves natural gas to the residential homes on both sides of the city street. At the time of the incident, the cast iron main was operating at approximately 30-inches water column (IWC), where one pound per square-inch gauge (psig) equals approximately 27.71 IWC. The maximum allowable

operating pressure for the 6-inch diameter pipeline involved in the incident is approximately 61 IWC, or approximately 2.2 psig.

Several pipeline replacement activities have taken place since original installation of the 6-inch diameter cast iron main. Of which, in May 1998, 42 feet of 6-inch diameter steel pipeline replaced a section of the cast iron main near 3421 and 3425 Chestnut Avenue. Later in December of 1998, MGE reported a break in the 6-inch diameter cast iron main near 3414 Chestnut Avenue. One other report provided by MGE indicates a break in the cast iron main that necessitated 20 feet of cast iron main being abandoned and replaced with 20 feet of steel pipe.

In December 1908, a 1¼ -inch bare-steel service line was originally installed to serve 3441 Chestnut, but was replaced (March 1995) from main-to-meter with 7/8-inch diameter polyethylene (PE) pipe. More than 10 service lines in the 3400 block of Chestnut Avenue have been renewed prior to the date of the incident.

Previous Company Actions

• Odorization Records •

Missouri Public Service Commission rules require MGE to maintain adequate concentrations of odorant in natural gas to be readily detectable at a concentration of less than 0.90 percent gas-in-air (% gas). Commission rules also require Missouri natural gas operators to verify that adequate levels are maintained through monthly testing. Company records of monthly odorant readings taken for three months prior to the incident indicated the natural gas was adequately odorized and readily detectable, no readings exceeded 0.60% gas. MGE obtained readily detectable concentrations ranging from 0.20% gas to 0.35% gas at several Chestnut Avenue residences on March 9, 2003.

• Leak Surveys •

The 6-inch diameter cast iron main beneath the 3400 block of Chestnut Avenue was last leak surveyed approximately seven months prior to the incident during July 2002 with no leaks detected. A prior leak survey was also conducted by MGE over the service line to 3441 Chestnut on September 13, 2002, with no detection of leaks. As recorded on the Company's Leak Summary Report, there were no known active leaks within the 3400 block of Chestnut Avenue prior to the incident. After completing repairs associated with this incident, leak surveys were again conducted by MGE on March 18, 2003, with no detection of leaks.

•Prior Construction Activities •

As mentioned above (***Natural Gas System***), in May 1998, the Company replaced 42 feet of cast iron main near 3421 and 3425 Chestnut Avenue with an equivalent section of 6-inch diameter steel pipe. Company records indicate this replacement was necessary as a result of undermining of the cast iron main from a sewer line collapse. Several other construction activities have taken place within the 3400 block of Chestnut Avenue during the time period of 1995 to the end of 2002. Documents provided by the Company depict several MGE originated construction activities involving service line replacements and main repairs, but none involving construction at the location of the cast iron main break associated with this incident.

Construction activities within the 3400 block of Chestnut Avenue during 1995 to 2002 have not been limited to MGE excavations. The Company has provided documents indicating excavation activities by the City of Kansas City (City), who operates the water and sewer utilities in the area of the incident. Documents provided by MGE show locate requests pertaining to water utility excavations within the 3400 block of Chestnut Avenue. However, none of the locate request documents indicate excavations being made in the immediate area of the 6-inch diameter cast iron main break involved with the incident. The Company also provided a document of an excavation permit receipt that was issued by the City of Kansas City to Pollution Control. This excavation permit receipt was accepted by the City on July 27, 1998, and indicates a proposed excavation located 15 feet east of the west curb line of Chestnut Avenue and 150 feet north of the north curb line of 35th Street (Appendix C – Exhibit C-1). MGE reports that they only became aware of the excavation permit when Company personnel visited a City office after the incident to research other excavation permits that might be related to this incident. As indicated above, MGE states that the Company did not receive notice of any locate request for this excavation activity.

MGE's Cast Iron Main Replacement Program

Regulation 4 CSR 240-40.030(15)(D), which became effective December 15, 1989, required all operators with cast iron pipe to develop and submit a systematic replacement program. The regulations specify that the program be prioritized to identify and eliminate cast iron piping that presents the greatest potential for hazard. The Company filed its initial proposed replacement program for cast iron piping with the Commission in Case No. GO-91-277. The program outlined a replacement schedule for certain cast iron mains. The purpose of the program was to identify, set priorities, and systematically replace facilities as approved by the Commission. Subsequent to Case No. GO-91-277, the Company filed Case No. GO-2002-50 that was also approved by the Commission. Case No. GO-2002-50 revised and combined the Company's ongoing cast iron main and service/yard line replacement as part of MGE's overall Safety Line Replacement Program. This is MGE's most recently approved cast iron replacement program.

MGE reported in Case No. GO-2002-50 that its cast iron main replacement program has resulted the in the replacement of approximately 300 miles of cast iron main.

The Company's cast iron replacement program, which contains a specific priority schedule and an on-going long-term program, intends to eliminate those high priority categories of cast iron pipe that present the greatest potential for hazard. The Company prioritized the cast iron pipe into categories that would take into account all available information considering the cast iron pipe's condition and environment. This information includes, but is not limited to, high pressure cast iron beneath continuous pavement, high pressure cast iron near concentrations of people, small diameter cast iron, areas of extensive excavation activities, areas of planned future development, soil type and condition, traffic loading, depth of cover, operating pressure, leak cause, and pipe condition, including indications of graphitization. A mapping system for breaks in cast iron is also integrated into the Company's program and facilitates in targeting areas for replacements.

As part of the Company's cast iron replacement program, emphasis is to be placed on cast iron mains as required by Commission Rule 4 CSR 240-40.030(13)(Z) – Protecting or Replacing Disturbed Cast Iron Pipelines.[1] All Company cast iron mains, including the 6-inch diameter cast iron main in the 3400 block of Chestnut Avenue, are covered in MGE's replacement program as required by Rule 4 CSR 240-40.030(15)(D). The documentation received from MGE at this time does not specifically state any Company actions taken to protect disturbed cast iron mains while third-party excavations occurred near the 6-inch diameter cast iron main. MGE indicates that prior to the incident, the 6-inch diameter cast iron main located in the 3400 block of Chestnut Avenue did not meet the requirements for replacement pursuant to the Company's cast iron main replacement program.

Incident Reporting Requirements

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

[1] 4 CSR240-40.030 (13)(Z) states that when an operator has knowledge that the support for a segment of buried cast iron pipeline is disturbed or that an excavation or erosion is nearby, the operator shall determine if more than half the pipe diameter lies within the area of affected soil. If so, that segment of pipeline must be protected, as necessary, against damage during the disturbance by heavy construction equipment, impact forces, earth movement, water leaks or sewer failures that could remove or undermine pipe support, apparent future excavations near the pipeline, or other foreseeable outside forces. After the disturbance, this segment of pipeline must be replaced or permanently protected, except as provided in (13)(Z)4.

1. Initial notification of a natural gas incident was made to the MoPSC Staff's answering service on Sunday morning, March 9, 2003, who then contacted Staff personnel at approximately 11:30 a.m. that same morning.

2. U.S. Department of Transportation form RSPA F 7100.1 was received at the MoPSC on March 20, 2003.

MoPSC Staff Investigation

One member of the Commission's Energy Department – Safety/Engineering Staff responded to the incident scene and began investigations upon arrival at approximately 2:50 p.m. the day of the incident, Sunday, March 9, 2003. Fire department personnel and Company representatives were on-site and provided information and described actions taken up to that point. An MGE representative explained that a gas odor notification was received from an occupant at 3433 Chestnut at approximately 10:00 a.m. An MGE service person responded and arrived on-site approximately 25 minutes later. Initial investigations of the MGE respondent resulted in a 20% gas reading taken in the free atmosphere within 3433 Chestnut. MGE's operation and maintenance standards covering hazardous atmospheres requires immediate evacuation when concentrations of flammable gas at, or in excess of, 20 percent of the lower explosive limit (1% gas) in freestanding air is detected within a structure (Appendix C, Exhibit C-2).

The MGE representative continued to explain that the MGE service person then proceeded to the inside meter set, located in the basement of the home, and turned the inlet meter valve to the "off" position. A gas-in-air reading was then taken at the basement floor drain and another 20% gas reading was obtained, at which time a loud explosion was heard. After receiving the gas-in-air reading from the floor drain and hearing the explosion, it was described that the MGE service person instructed the residents to immediately evacuate the home. Once outside, the MGE service person ran up to the steps of 3441 Chestnut, where he saw three young girls exiting the home. Assistance was provided to the three young girls before efforts were made to evacuate neighboring homes and to call for additional assistance.

Additional MGE personnel were then requested. Upon the arrival of the additional MGE personnel, leak investigations continued that lead to the excavation efforts to expose the origin of the leak. While Company efforts were being made to excavate what was believed to be the leak origin, other Company efforts were being made to monitor gas-in-air readings found within structures, beneath street pavement, and in sewer mains, with readings varying with location. MGE also excavated the service line tap to 3441 Chestnut (Appendix A, Figure A-2) to conduct a pressure test on the service line prior to retiring the plastic pipeline from service. The result of the pressure test indicated no signs of leakage.

The residence at 3441 Chestnut had been completely destroyed by the explosion and subsequent fire. Hazardous conditions restricted access within the home for the purpose of sampling the sewer drains for any gas-in-air readings, however, percentages of gas-in-air readings were found in the basement floor drain of 3433 Chestnut and within sewer manholes at the 35th Street and 3400 block of Chestnut Avenue intersection. Other investigations included observations of the surrounding area and discussions with fire department personnel.

As excavation continued to expose the origination of the leaking natural gas, examination was made of soil conditions over the 6-inch diameter cast iron main. A 4-foot by 16-foot excavation in the street, near the base of the driveway to 3441 Chestnut, revealed backfill material consisting primarily of sand and gravel (Appendix B-1, Photograph 2). The street over the leak location consisted of various layers of asphalt and/or concrete, with only an approximate 3 to 4-inch layer of asphalt east of the excavation and approximately 11 to 12-inch thick layering of asphalt/concrete (Appendix B-1 and B-2, Photographs 2 and 3, respectively) west of the excavation.

Shortly before 4:00 p.m., a circumferential crack was discovered on the 6-inch diameter cast iron main (Appendix B-2, Photograph 4). The fracture extended from the 1 o'clock position to the 11 o'clock position, with greatest separation of the cast iron main (1/8-inch) occurring at the 6 o'clock position, or the bottom of the pipe. MGE construction personnel were able to install a full encirclement clamp to stop the leaking natural gas. The Company expressed that this was a temporary repair as plans were being made to have the section of cast iron main, which included the crack, replaced.

The 6-inch diameter cast iron main in the 3400 block of Chestnut Avenue was replaced with 4-inch diameter PE piping on April 24, 2003.

Witness Interviews

On the morning of March 9, 2003, a resident of 3433 Chestnut detected a strong odor of natural gas outside of the home. The resident's spouse also detected a strong natural gas odor inside the home and called MGE to report the odor. The resident stated that the Company promptly responded and began to conduct investigations for natural gas leaks. To the best of the resident's knowledge, the MGE service person checked the atmosphere upon entering the home and then checked the stove before advancing to the basement level. Once in the basement, the MGE service person was said to have examined the furnace and hot water heater before checking the inside meter set. After checking the inside meter set, the resident stated they heard an explosion and they rushed out of the home with the serviceperson. When asked if either resident had

detected a natural gas odor inside or outside of their home prior to the day of the incident, the response was no, they had not detected any natural gas odors prior to the day of the incident.

ANALYSIS

Failure of the Cast Iron Main

Cast iron is a general name given to a wide range of alloys containing iron, carbon, silicon, and to a lesser extent, manganese, phosphorus, and sulfur. Cast iron is a material that is cast in a mold. Because cast iron has a low ductility characteristic, it is considered to be very brittle. Pipeline materials currently installed by natural gas operators, such as steel and polyethylene plastic, have more ductility. They begin to deform at stress levels approaching the yield point and with increasing stress, continue to deform until fracture. Cast iron deforms very slightly before fracture. When subjected to stresses greater than the yield point, failure of the material is sudden and typically results in a circumferential fracture.

Some causes of stress-induced fracture of cast iron are: 1) vibration from a nearby source such as excavation equipment, blasting operations, traffic, demolition, or earthquakes; 2) settlement of surrounding soil due to backfill; 3) downward forces imposed by heavy surface objects such as vehicles; 4) force from the freezing and thawing action of the soil; 5) force from the expansion and contraction of soils due to wet/dry cycles; and 6) any combination of those above.

Without question, utility excavation activities within the 3400 block of Chestnut Avenue have been prevalent over the past ten to fifteen years. Much of these excavation activities occurred as part of routine maintenance to facilities that have a long history of service to a neighborhood that dates back to the early 1900's. As the break in the 6-inch diameter cast iron main was being uncovered, it was evident that prior excavation activities had taken place at the location of the break. While there was no apparent evidence of the cast iron main sustained a hit, or gouge, due to prior excavation, backfill of loose compaction encompassed the cast iron main for most of the 4-foot by 16-foot excavation. Difference in street covering, most likely concrete street patches poured to cover excavation holes, also provides evidence of prior excavations made at the location of the fractured cast iron main. During these excavations, it is not known to what degree of support, if any, was given to the cast iron main. To combine factors of insufficient support to the cast iron main during excavations, loose backfill compaction, the cast iron main's location beneath Chestnut Avenue with the stresses of daily vehicular traffic occurring above, probable conditions exists for a stress-induced fracture to occur to the cast iron main.

Natural Gas Migration and Accumulation

The natural gas emanating from the fracture in the six-inch cast iron main would have exited with a pressure of approximately 30 IWC and permeated the immediate soil. Once out of the

confines of the cast iron main, pressure, volume, and porosity of the media it moves through will greatly determine the path(s) taken by the escaping natural gas. The natural gas is lighter than air and will migrate along paths of least resistance through the soil and upward to the atmosphere where possible. The porous soil (sand and gravel) surrounding the cast iron main break would have allowed the natural gas to move more freely than had it been in compacted soil conditions, such as clay. As the escaping natural gas began to permeate the soil and rise, it encountered the concrete and asphalt street coverings, which would have limited the upward migration of the natural gas to the free atmosphere. The low operating pressure, approximately 1 psig, of the cast iron main would not have given the migrating natural gas the "push" that a higher operating pressure, say 20 to 60 psig, could give, but the disturbed soil conditions and nearby sewer and water facilities provided other avenues for the natural gas to take.

The natural gas leaking from the fracture in the 6-inch diameter cast iron main was detected over a widespread area. Gas-in-air readings obtained in bar-holes made in the street from 34th Street to 35th Street provided evidence of this, as well as, gas-in-air readings (20%) found in the basement floor drain of 3433 Chestnut and in sewer manholes at the Chestnut Avenue and 35th Street juncture. Although natural gas was migrating through the soil, and it is capable of entering structures through fissures or voids in foundation walls, the presence of the natural gas in the sewer indicates the possible migration path to 3441 Chestnut occurred through the home's sewer lateral. This occurred at 3433 Chestnut as verified by the MGE serviceman's 20% gas readings in the free air and basement floor drain. Natural gas has a lower explosive limit of approximately 4.5% gas-in-air and upper explosive limit of approximately 14.5% gas-in-air. Gas-in-air concentrations below 4.5% or above 14.5% will not burn or ignite.

Once the natural gas migrated into 3441 Chestnut and accumulated to within the explosive range, it was ignited by an unidentified ignition source. Although the ignition source was not identified, three girls were inside the structure at the time of the explosion and several sources were available in the home. As previously mentioned, natural gas at concentrations above the explosive range were detected inside 3433 Chestnut. Had an ignition source inside of 3433 Chestnut been introduced to lower concentrations (below the 20%) that were within the explosive range of natural gas, conditions inside this home would have also been suitable for an explosion.

MGE Emergency Leak Investigations

A post-incident interview with a resident of 3433 Chestnut determined that a natural gas odor was detected inside and outside of the home prior to the incident. An odor notification was then made to MGE, and a MGE serviceman arrived to investigate. One of the first gas-in-air readings taken by the serviceman was of the free atmosphere inside of 3433 Chestnut, which resulted in a

20% gas reading. The MGE serviceman continued investigations inside the home without attempting to evacuate persons from the home. Accounts of the MGE serviceman's actions, as told by the resident of 3433 Chestnut, indicate the residents were present inside their home during the leak investigations. These accounts are consistent with Company statements given after the incident.

MGE has established and maintains an operations and maintenance manual of written procedures for conducting operations and maintenance activities and for emergency response, as required by Commission Rule 4 CSR 240-40.030(12)(C). MGE procedures for entering hazardous atmospheres, as shown in Appendix C, Exhibit C-2, clearly state what a Company employee should do when there is reason to suspect the possibility of escaping natural gas inside a home. When reasons exist to believe natural gas is inside a home, a Company employee is to test atmospheric conditions upon entering the home. If natural gas concentrations within the free air of the home should exceed 1% gas, an evacuation must be initiated.

Parts 4.4.1 and 4.4.2 of the above mentioned MGE procedures (Appendix C, Exhibit C-2) explain the Company's requirements for an event requiring evacuation, clearly stating what to do when the source of the leaking gas is known (or unknown) to be located inside or outside the home. Every natural gas operator's emergency procedures, in accordance with Commission Rule 4 CSR 240-40.030(12)(J), are to provide for taking actions directed towards protecting people first and then property, as well as, making safe any actual or potential hazard to life or property. When the MGE serviceman obtained initial readings of 20% gas from the free atmosphere inside 3433 Chestnut, immediate evacuation should have occurred. The residents detected natural gas odors inside and outside of the structure; the MGE serviceman did not know the location of the source of leaking natural gas; gas concentrations in excess of the upper explosive limit (14.5%) were obtained in the free atmosphere inside 3433 Chestnut, and yet the MGE serviceman continued investigating inside the home in lieu of taking actions towards protecting people first. Lives were unnecessarily kept in a hazardous condition.

Had an ignition source been introduced to an area of the home where gas concentrations were within the flammable range of natural gas, which could have easily happened, an explosion would have most likely occurred from within 3433 Chestnut that same day. The heightened awareness of MGE's procedures for hazardous atmospheres, as a result of the MGE serviceman's lack of action taken prior to the explosion has hopefully impacted all personnel in order to minimize the possibility of a similar occurrence in the future.

Excavation Activities Near MGE's Cast Iron Mains

Evidence collected in support of this report has not conclusively satisfied all questions regarding the excavation activities near, and protection of, MGE's cast iron mains beneath Chestnut Avenue. Further investigations and evaluations are needed in the areas pertaining to the requirements of Case Nos. GO-91-277 and GO-2002-50 (MGE's cast iron main replacement programs) and Missouri Public Service Commission pipeline safety rules 4 CSR 240-40.030(12)(I) – Damage Prevention Program and 4 CSR 240-40.030(13)(Z) – Protecting or Replacing Disturbed Cast Iron Pipelines.

Through its investigation into this incident, Staff has identified several issues that should be further investigated. The facts and findings pertaining to this incident show a prior excavation occurring at the fracture of the 6-inch diameter cast iron main and Company statements indicating they were not aware of such excavation. This particular instance involves gathering information from third party excavators, MGE, a one-call center, and possibly other City offices. Broadening this evaluation for the purpose of encompassing MGE's entire cast iron main replacement program and for preventing any potential reoccurrences from happening will require addition investigations. It has not been determined as to whether this incident was an isolated occurrence or whether it could occur elsewhere in the Company's operations, nor has the extensiveness of the relationship between this incident and MGE's revised cast iron main replacement program (Case No. GO-2002-50) been determined.

CONCLUSIONS

1. At approximately 10:25 a.m., CST, on Sunday, March 9, 2003, a MGE serviceman arrived at 3433 Chestnut in response to a customer gas odor notification. While conducting investigations at 3433 Chestnut, an explosion and subsequent fire occurred at 3441 Chestnut in Kansas City, Missouri.

2. As a result of the explosion and fire at 3441 Chestnut, MGE estimated the property damage at approximately $50,000. Three young girls were inside 3441 Chestnut when the explosion occurred. They were able to exit the home to a safe location without suffering any reported injuries.

3. The probable cause of the incident was the ignition of natural gas, which had accumulated in the residence of 3441 Chestnut. The natural gas escaped and migrated from a circumferential fracture in a 6-inch diameter cast iron gas main located beneath Chestnut Street. The emanating natural gas permeated the surrounding soil and most likely entered 3441 Chestnut through a sewer lateral. The source of ignition was not determined.

4. The cause of the cast iron main fracture was the application of external forces in combination with insufficient pipe support from backfill material, which resulted in induced stresses beyond the yield point at the fracture location. Records indicate that sewer excavation activities occurred in the area of the fracture and backfill material consisting of sand and gravel provide evidence of prior excavation activities. MGE reports that it was not aware of the sewer excavation and did not receive a locate request notification.

5. The 6-inch diameter cast iron main located beneath Chestnut Avenue had two sections of cast iron pipe replaced with steel pipe prior to the incident. On one of these occasions (May 1998), MGE records report the cause of the cast iron main break resulting from undermining of the main during an excavation project to repair a collapsed sewer. The cast iron main beneath the 3400 block of Chestnut Avenue was replaced with PE pipe during April 2003.

6. Odorant concentration tests conducted on the natural gas in the distribution system, prior to and after the incident at 3441 Chestnut, indicated the natural gas was adequately odorized as required by Commission pipeline safety regulations.

7. The Staff believes that MGE violated 4 CSR 240-40.030(12)(C) which states: "Each operator shall prepare and follow for each pipeline, a manual of written procedures for

conducting operations and maintenance activities and for emergency response." The Company has adequate written procedures for what to do when encountering a hazardous atmosphere during an odor notification investigation. MGE requires appropriate personnel to conduct certain levels of evacuation of people when 1% gas is detected inside a home. The MGE serviceman did not follow Company procedures during his leak investigation at 3433 Chestnut. The level of gas concentrations found (20% gas) by the MGE serviceman warranted immediate actions directed toward evacuation of the residents. As a result of the MGE serviceman's lack of acknowledgement of the existing conditions and failure to follow Company procedures, lives were unnecessarily kept in a hazardous condition. Had a proper ignition source been introduced to gas concentrations within the flammable range of natural gas, an explosion would have most likely occurred at 3433 Chestnut.

8. The Staff's investigation revealed a probable violation of Missouri Public Service Commission's regulation 4 CSR 240-40.030(12)(C) and has requested that the Office of General Counsel file a complaint against MGE.

9. Based upon the number of excavations occurring near and around the 6-inch diameter cast iron main located beneath 3400 block of Chestnut Avenue and MGE's statement of not receiving any prior notification of third party excavation occurring near the cast iron main fracture associated with this incident, the Staff believes that a 6-month time period is needed to further evaluate this Case and MGE's programs and procedures related to cast iron mains.

RECOMMENDATIONS

1. It is recommended that MGE analyze the incident and the failure of proper evacuation of people to instruct all Company personnel in proper emergency response procedures, including the early recognition of a hazard situation, and the fastest and safest method for removing people from a potentially hazardous site. The lessons learned from the circumstances of the March 9, 2003, incident should be incorporated into Company training. Additionally, MGE should review with the Company serviceman who initially responded to the odor notification its policies and procedures of appropriate emergency response, specifically those procedures for entering hazardous atmospheres.

2. It is recommended that MGE immediately began reinforcing communications with the City of Kansas City, as well as other operators of sewer and water utilities located within other MGE's operations. This communication should stress the importance and need for notifications and Company inspections of cast iron mains located within or near the other operator's proposed excavation. MGE should also convey the necessity of proper backfill and compaction around its cast iron mains and explain the perils of undermining such pipelines.

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

4. The Staff recommends that this Case remain open for a period of 6 months to conduct further investigations for the purpose of evaluating MGE's cast iron replacement program. Specifically, Staff believes that further evidence is needed to make accurate recommendations to the Company that properly address: inspections of cast iron mains during third party excavations; liaisons with other utility operators; undermining and supporting of cast iron mains during excavations; proper backfill practices; and overall effectiveness of MGE's cast iron replacement program as it pertains to third party excavations occurring near MGE's cast iron mains and the replacement schedules for those particular pipelines.

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

APPENDIX A
(Figures)

Figure 1
Overall View of 3441 Chestnut Avenue
Appendix A-1

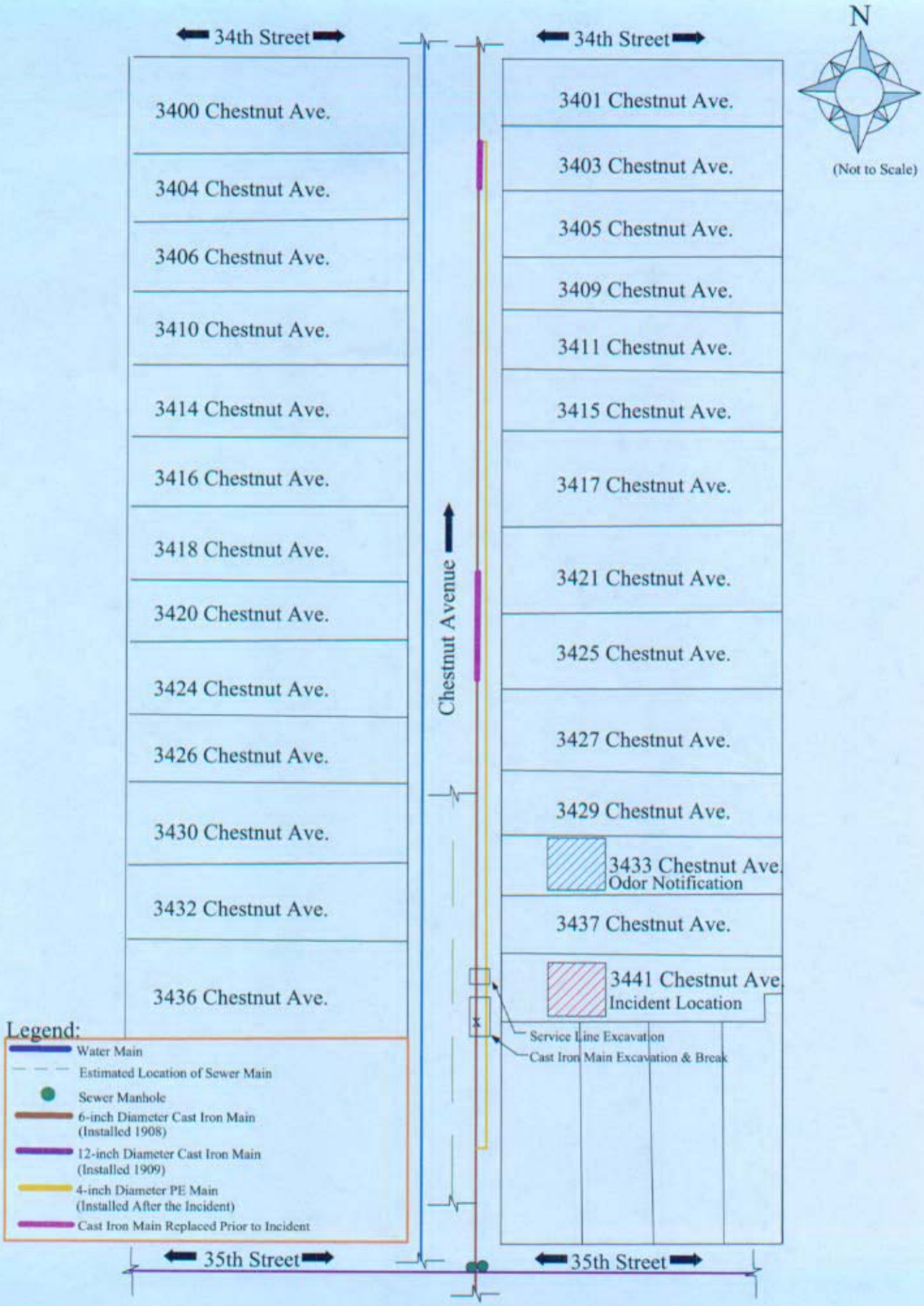
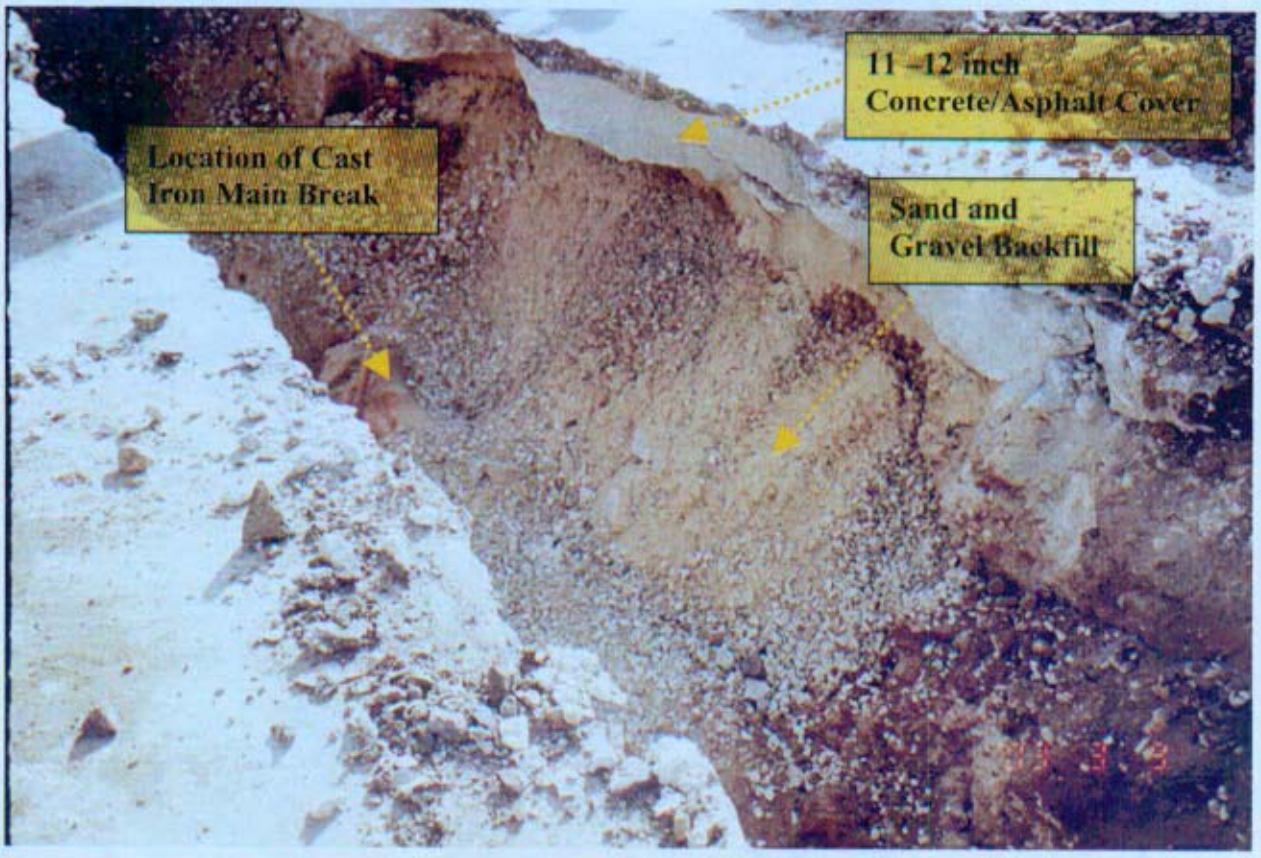


Figure 2
Plan View of 3441 Chestnut Avenue
Appendix A-2

APPENDIX B
(Photographs)

Photograph 1. – View looking east at damages suffered by 3441 Chestnut Avenue as a result of the explosion and subsequent fire.

Photograph 2. – Viewing looking southeast at excavation of the 6-inch diameter cast iron main and surrounding backfill material. Note most backfill material consisted of sand and gravel.



Photograph 3 – Looking southwest at the backfill material.

Photograph 4. – View of circumferential crack in 6-inch cast iron main. The crack extended from the 1 o'clock position to the 11 o'clock position. The worker's left thumb marks the 11 o'clock position.

APPENDIX C
(Exhibits)

CITY OF KANSAS CITY, MISSOURI
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

EXCAVATION PERMIT(S) RECEIPT

PERMITEE	POLL CONTROL	REFERENCE NUMBER	70054739
ADDRESS	414 E. 12TH ST	ISSUE DATE	07/08/98
	KANSAS CITY MO 64106	EXPIRATION DATE	10/06/98
TELEPHONE	274-2800	NUMBER OF PERMITS	1
		PERMIT(S) FEE	35

AT [redacted] AVE

IN JACKSON COUNTY, COUNCIL DISTRICT 03

TYPE WORK REPAIR IMPROVEMENT SEWER

SEWER CONNECTION NO SUBDIVISION

UTILITY APPROVAL NO WATER REGISTER NO

EXCAVATION LENGTH 00000000045 FEET DIVIDED BY 100 FEET EQUALS 1 PERMITS

IMPROVED 30'X50' UNIMPROVED _____ SIDEWALK _____ DRIVE _____

PARKING _____ EASMENT _____ OTHER _____

LOCATION 15' EWC of Chestnut ave ;
150' NNC of E 35TH ST

ACCEPTANCE DATE 7,27,98 INSPECTOR Tony

Excavation Permit for Sewer Construction Near 3441 Chestnut Avenue
Exhibit C-1

4.0 Structures

4.1 All gas-related structures must be tested for both gas concentrations and oxygen deficiency prior to entry. (Refer to O & M Standard 3550 - "Vault Inspection and Maintenance" for confined space access.)

4.2 When there is reason to suspect the possibility of escaping gas inside a non gas-related structure, the atmosphere within the structure shall be tested for gas concentrations. A customer complaint of a gas odor inside a home or the detection of gas adjacent to, or under, a structure is "reason to suspect".

4.3 Testing of atmospheric conditions at a point of entry to the structure shall be conducted prior to entry.

4.4 When concentrations of flammable gas at, or in excess of, 20 percent of the lower explosive limit (1 percent gas) in free-standing (ambient) air is detected within a structure, the following actions shall be taken :

4.4.1 If the source of gas is known to be located outside the structure or is unknown but could be located outside the structure, evacuate all occupants from the entire structure immediately and test adjacent structures.

4.4.2 If the source of gas is known to be inside the structure the level of evacuation should be based on the amount of gas detected and the employee's judgment but at a minimum requires evacuation of any room where gas is detected at levels stated above, and all rooms immediately adjacent including above and/or below.

4.4.3 Shut off the gas supply to the structure.

4.4.4 Establish and identify a restricted zone. This may be accomplished by using warning tape to identify the zones perimeter.

4.4.5 Eliminate all sources of ignition.

4.4.6 Open doors and windows to ventilate, if practical. Concentrations greater than the 100% LEL (5% gas) level may require the assistance of fire department or emergency response personnel in determining and initiating a safe ventilation process.

4.4.7 Remove vault, manhole, and valve box covers, as appropriate.

4.4.8 Vent any escaping subsurface gas directly to the atmosphere by digging over the point where gas is entering or adjacent to the building, if appropriate.

4.5 Access to the structure or room(s) shall not be permitted without appropriate Personnel Protective Equipment identified in section 6.0 or until the concentrations have been reduced to levels below that identified in 2.1.1.