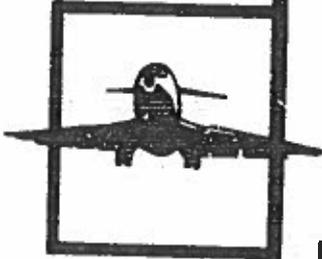


PB82-916503



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

PIPELINE ACCIDENT REPORT

MISSOURI POWER AND LIGHT COMPANY
NATURAL GAS FIRES
CENTRALIA, MISSOURI
JANUARY 28, 1982

NTSB-PAR-82-3

UNITED STATES GOVERNMENT

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<p>16. Abstract About 10:30 a.m., e.s.t., on January 28, 1982, at Centralia, Missouri, natural gas at 47 psig entered a low pressure distribution system which normally operated at 11 inches water column (0.40 psig) after a backhoe bucket snagged, ruptured, and separated the 3/4-inch-diameter steel pressure regulator control line at the Missouri Power and Light Company's district regulator station No. 1. The backhoe, which was owned and operated by the city of Centralia, was being used to clean a ditch located adjacent to the pressure regulator station. The high pressure gas entering customer piping systems in some cases resulted in high pilot light flames which initiated fires in buildings; while in other cases, the pilot light flames were blown out, allowing gas to escape within the buildings. Of the 167 buildings affected by the overpressure, 12 were destroyed and 32 sustained moderate to heavy damages. Five persons received minor injuries.</p> <p>The National Transportation Safety Board determines that the probable cause of the accident was the rupture of a pressure regulator control line by a city operated backhoe and the isolation by the gas company of a related relief valve which allowed natural gas at 47 psig to enter the low pressure distribution system, rather than to vent to the atmosphere. Contributing to the accident was the failure of city officials to notify the gas company of its excavation operations and the failure of the gas company to take prompt action to adjust the relief valve and restore it on line.</p>					
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CONTENTS

SYNOPSIS	1
INVESTIGATION	1
The Accident	1
Injuries to Persons	5
Damage to Pipeline	5
Fire Damage	5
Meteorological Information	5
Pipeline Information	5
Survival Aspects	14
Training	14
Pressure Regulating Station Designs	16
Pressure Regulator Station Inspections	17
Test and Research	17
Other Information	18
ANALYSIS	19
General.	19
Regulator Station	21
Excavation Damage Prevention	22
CONCLUSIONS	23
Findings	23
Probable Cause	24
RECOMMENDATIONS	24
APPENDIXES	27
Appendix A--Investigation	27
Appendix B--District Regulator Station No. 1 (Low Pressure Chart).	28
Appendix C--District Regulator Station No. 1 (High Pressure Chart)	29
Appendix D--Tests performed on February 3 and May 7, 1982.	30
Appendix E--Gas Regulator Station No. 1, Pressure Relief-Annual Inspections and Checks	34

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WASHINGTON, D.C. 20594**

PIPELINE ACCIDENT REPORT

Adopted: August 24, 1982

**MISSOURI POWER AND LIGHT COMPANY
NATURAL GAS FIRES
CENTRALIA, MISSOURI
JANUARY 28, 1982**

SYNOPSIS

About 10:30 a.m., e.s.t., on January 28, 1982, at Centralia, Missouri, natural gas at 47 psig entered a low pressure distribution system which normally operated at 11 inches water column (0.40 psig) after a backhoe bucket snagged, ruptured, and separated the 3/4-inch-diameter steel pressure regulator control line at the Missouri Power and Light Company's district regulator station No. 1. The backhoe, which was owned and operated by the city of Centralia, was being used to clean a ditch located adjacent to the regulator station. The high pressure gas entering customer piping systems in some cases resulted in high pilot light flames which initiated fires in buildings; while in other cases, the pilot light flames were blown out, allowing gas to escape within the buildings. Of the 167 buildings affected by the overpressure, 12 were destroyed and 32 sustained moderate to heavy damage. Five persons received minor injuries.

The National Transportation Safety Board determines that the probable cause of the accident was the rupture of a pressure regulator control line by a city operated backhoe and the isolation by the gas company of a related relief valve which allowed natural gas at 47 psig to enter the low pressure distribution system, rather than to vent to the atmosphere. Contributing to the accident was the failure of city officials to notify the gas company of its excavation operations and the failure of the gas company to take prompt action to adjust the relief valve and restore it on line.

INVESTIGATION

The Accident

Control Line Break.--Early on the morning of January 28, 1982, the Centralia City Hall received a complaint from a resident that a 10-inch culvert (located adjacent to regulator station No. 1) was clogged with mud and debris and was not draining properly. (See figures 1 and 2.) The city's street-foreman (a heavy equipment operator) and a three-man crew were assigned the task of cleaning out the ditch so that the culvert could drain. The foreman was not informed of any underground pipeline facilities in that location nor was he shown any maps of buried facilities. According to the foreman and City officials, the Missouri Power and Light Company (gas company) was not notified because the cleanup operation was considered routine and was not considered to be an excavation operation.

About 10:25 a.m., the foreman began cleaning the ditch, using a backhoe. In later testimony, the foreman said that he originally planned to clear the opening to the buried culvert using picks and shovels, but because of the cold weather, the ground was frozen and consequently, the backhoe was brought in.

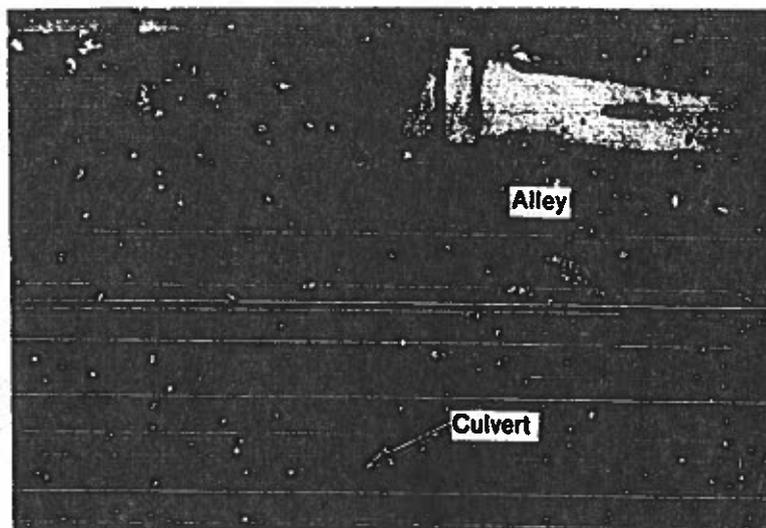


Figure 1.--View of 10-inch diameter culvert.

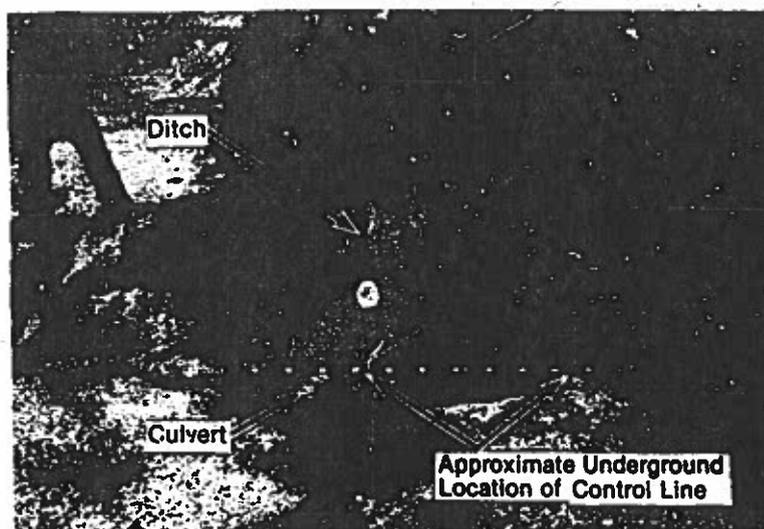


Figure 2.--View of culvert, ditch, and underground location of damaged control line

About 10:30 a.m., the backhoe bucket snagged and ruptured the No. 1 regulator station's 3/4-inch-diameter steel control line, which was located 12 inches below the culvert bottom, and perpendicular to the ditch. The regulator sensed atmospheric pressure and failed wide open. Natural gas at 47 psig entered the low pressure system, and some gas escaped from the section of the control line still attached to the low pressure cast iron main. The attached section which was partially open pointed upward toward station No. 1. (See figure 3.) The foreman said that he heard a "hissing noise from the ground pipe" and immediately ordered a crewman to go by truck to City Hall and call the gas company. The foreman then moved the backhoe about 100 feet away from the damaged control line.

About 8 minutes later, a gas company line service worker arrived at the accident site. The line service worker said that he saw the broken line outside the regulator station, smelled the natural gas, and heard the escaping gas which, at a pressure of 47 psig, sounded "like a jet engine." After surveying the damage, the line service worker shut down the high pressure valve with an adjustable wrench and "wheeled" down the low-pressure valve. The noise of the escaping gas stopped.

Fires.--Meanwhile, at 10:31 a.m., a resident had notified the Centralia Fire Department of a fire at his home. By the time the department's 3 firetrucks and 17 volunteers had arrived on the scene, fires had erupted in different sections of the city. Because of the limited number of local police officers, firefighting personnel, and equipment, the Centralia police chief requested assistance from neighboring communities. Approximately 150 firemen, 35 firefighting units, and 8 ambulances from 21 Missouri communities responded.

During one point in the firefighting efforts, about 44 houses and businesses were burning at the same time. Firemen spent about 15 minutes on fires that normally would have taken 2 hours to extinguish. When firemen concluded that they could not save a structure, they abandoned it and moved on to another structure. The worst fires involved those with basement furnaces where flames were fueled by flammable materials in the structures. By 2:00 p.m., the fires had been extinguished or had been brought under control.

Gas Company Activities.--At the time of the pipeline rupture, only two gas line service workers were on duty at the Centralia local office. The repair crew assigned to Centralia was on call in Mexico, Missouri.

The records of the dispatcher located in Mexico indicated that a Centralia customer reported gas blowing in a house at 10:36 a.m. Immediately, the dispatcher called one of the gas line service workers in Centralia and sent him to investigate the reported trouble. At 10:36:30 a.m., the dispatcher called the gas district supervisor who was in Mexico and sent him to Centralia.

At 10:37:00 a.m., a caller reported gas blowing loudly in a department store. At 10:37:30 a.m., the dispatcher told the assistant district superintendent, who was nearby in the building, that they might have high pressure gas in the low pressure system. The assistant district superintendent left for Centralia.

At 10:38:00 a.m., a Centralia customer called the gas company's auditor and reported that a pipe had broken behind his office. The auditor notified the dispatcher who at 10:38:30 a.m., radioed the second line service worker in Centralia. At the time, the line service worker was on another service call. The dispatcher told him about the broken pipe and the location and ordered him to go to that location.

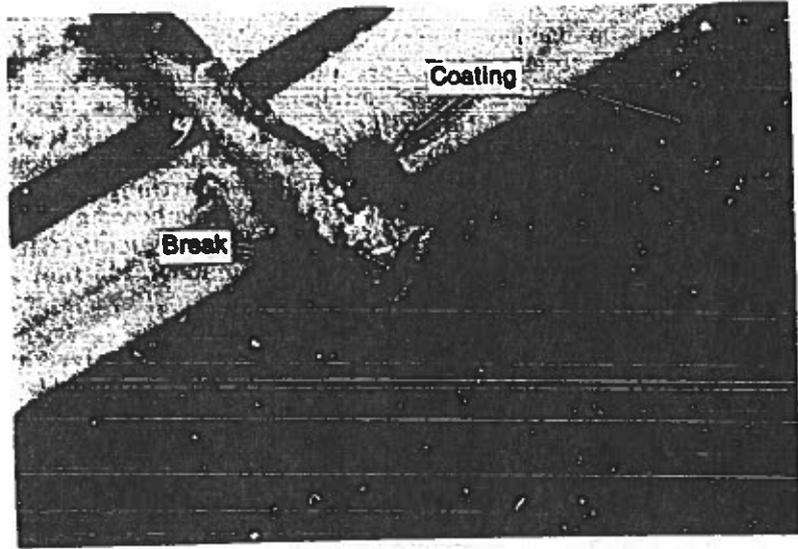


Figure 3.-- End view of broken control line.

At 10:42:00 a.m., the second line service worker reported to the dispatcher that the control line had broken at the Tip-Tool Station (station No. 1) and was "high-pressuring." The dispatcher relayed the information via radio to the assistant district superintendent, who was en route to Centralia. The assistant district superintendent ordered the station shut off immediately. The dispatcher then radioed the line service worker and told him to shut off the Tip-Tool Station.

At 10:44:00 a.m., the second line service worker reported to the dispatcher that the station was shut down; 8 minutes had elapsed from the first telephone call to the gas company and 14 minutes had elapsed since the control line was ruptured.

At 10:46:00 a.m., a Centralia customer reported gas odors inside his house. The dispatcher immediately reported the call to the second line service worker. At 10:46:30 a.m., the Centralia Police Department reported gas in many houses in Centralia.

At 10:47:00 a.m., a Centralia customer reported gas blowing loudly in a house; the dispatcher relayed the information to the assistant district superintendent.

At 10:48:00 a.m., the dispatcher reported the overpressurization to the district superintendent who was in Mexico. The district superintendent left immediately for Centralia.

At 10:50:00 a.m., a Centralia customer called and asked if there was a gas problem at his house.

At 11:01:00 a.m., the dispatcher briefed the manager of gas operations in Jefferson City, Missouri, on the overpressure condition of the low-pressure distribution system in Centralia; the manager immediately left for Centralia.

At 11:15:00 a.m., the dispatcher called the district manager in Boonville, Missouri, and reported that high pressure gas had entered the low pressure system in Centralia. The district manager left immediately for Centralia. At the time, the assistant district superintendent, the gas district supervisor, and the first line service worker were discussing additional methods of reducing the pressure at the accident site. As a

precautionary measure, the assistant district superintendent ordered the gas district supervisor and the line service worker to shut off the other three regulator stations. However, after the control line rupture at Station No. 1, the regulators at Stations No. 2, 3, and 4 had closed automatically when they sensed the increase in pressure on the low pressure system; these stations were not adding gas to the system. Later however, after the pressure in the system stabilized and then began to drop back to the 11 inches W.C., regulator stations Nos. 2, 3, and 4 would have fed gas again into the system unless they were shut off. At 11:36:00 a.m., the dispatcher was informed by radio that all low pressure stations were turned off.

Between 10:30 a.m. and noon, 10 gas company employees in coordination with the police and fire department personnel evacuated residents, vented the affected buildings, and shut off the gas at the meters.

At 2:00 p.m., gas company personnel began a house-to-house check to insure that all gas meters had been shut off. Personnel turned off valves at all appliances to insure they were safe, and then turned on the gas meters at the residences and relit pilot lights on the appliances. The same procedure was followed at business establishments. By 6:45 p.m., gas service had been restored to all buildings not affected by the overpressure. Regulator station No. 1 was not returned to service until later.

Injuries to Persons

<u>Injuries</u>	<u>Gas Company Personnel</u>	<u>Fire Personnel</u>	<u>City Residents</u>	<u>Total</u>
Fatal	0	0	0	0
Nonfatal*	0	4	1	5
Total	0	4	1	5

*The five persons received minor injuries and were treated and released from the hospital on the same day.

Pipeline Damage

The only physical damage to station No. 1 was the rupture of its 3/4-inch diameter steel control line.

Fire Damage

Of the 167 buildings involved in the fires, 12 were destroyed and 32 sustained moderate to heavy damage. (See figure 4.)

Meteorological Information

At the time of the accident, the temperature was in the 30's with partly cloudy skies and moderate winds.

Pipeline Information

The city of Centralia, Missouri, is served by the Missouri Power & Light Company, a subsidiary of Union Electric of St. Louis, Missouri. The company is engaged principally in the transmission, distribution and sale of electric energy, and the distribution and sale

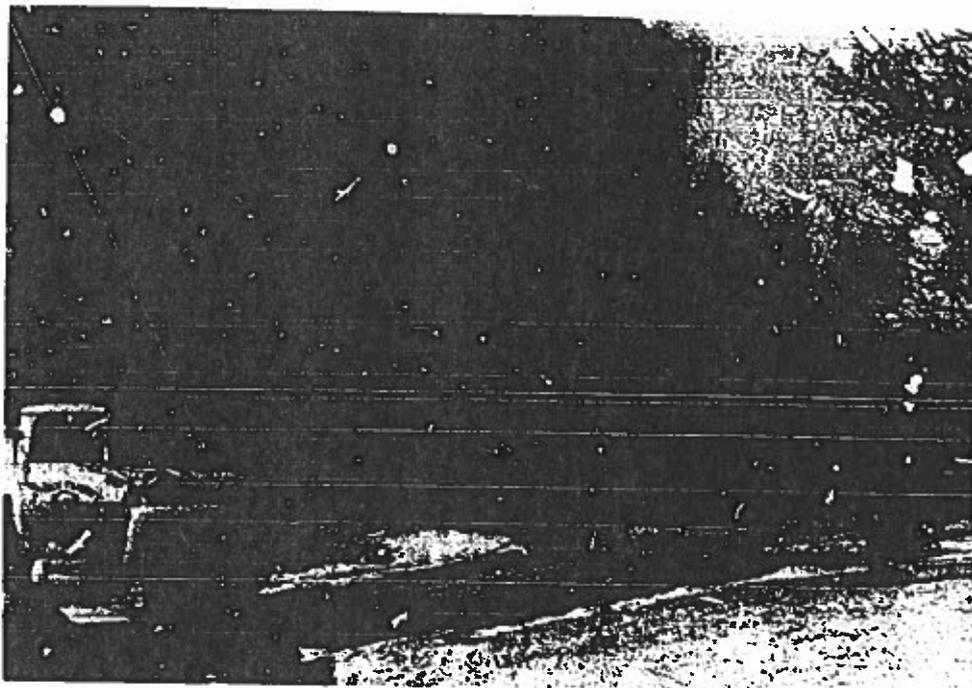


Figure 4.--View of fire at a Centralia residence.

of natural gas in a service area of 12,900 square miles in Missouri. Its service area extends from the Mississippi River to near the Kansas border, and from the foothills of the Ozark Mountains to the Iowa border. The company serves approximately 94,000 electric customers in 183 communities and rural areas, and 35,000 natural gas customers in 38 communities and surrounding suburban areas.

The gas company's district dispatching office is located in Mexico, Missouri. The dispatcher at that location handles all telephone calls, answers and relays all radio calls, records all incoming radio and telephone calls, and directs company personnel and equipment to investigate gas complaints for the district, which includes Centralia. The dispatching office in Mexico is manned from 8:00 a.m. to 5:00 p.m. daily. During all other hours, incoming telephone calls are automatically transferred to the central dispatching office at Moberly, Missouri, which is manned 24 hours per day.

The initial control of natural gas begins at the Panhandle Eastern Pipe Line Company's (Panhandle) town border station where incoming natural gas at approximately 350 psig is reduced to approximately 50 psig for delivery to the four district regulator stations (numbered 1 through 4) at Centralia. The natural gas pressure is further reduced at each district station to approximately 11 inches of water column (W.C.) (0.4 psig) ^{1/} for delivery to customers. Customers' pilot lights or burners are designed and regulated to operate in low pressure service, usually from an average of 5 to 7 inches of W.C. to a maximum of 14 inches of W.C. (approximately 1/8 to 1/2 psig pressure). The district regulators are the primary control devices in the low pressure distribution system and are the key components in the safe delivery of an uninterrupted supply of natural gas at an adequate pressure. (See figure 5.)

^{1/} One psig pressure equals 27.71 inches of W.C. pressure at 60° F.

Stations Nos. 1, 2, and 4 are located inside metal buildings (see figure 6), and station No. 3 is located within a metal bar fence (see figure 7). Stations Nos. 2 and 3 are monitoring stations and are equipped with a working regulator and a monitoring regulator to reduce and control the pressure of gas supplied to the distribution system. ^{2/} The working regulator is usually located upstream of the monitoring regulator and is set to maintain the desired downstream pressure. The monitoring regulator is set at a slightly higher pressure and, in the event the working regulator fails, the monitoring regulator will take over immediately and maintain a safe but slightly higher downstream pressure.

Regulator stations Nos. 1 and 4 are equipped with relief valves which are designed to prevent a system overpressure in the event that a pressure regulator fails by venting gas through a 4-inch steel pipe, or vent line. The vent line is attached to the outlet side of the relief valve and extends through the roof of the metal building where a rain cap and a flag are attached to it. (See figure 8.) When small pressure changes occur in the low pressure distribution system because of variations in gas demand throughout the day, the pressure fluctuations actuate the regulator diaphragm and cause the regulator to open further if more gas is needed or to close further if less gas is needed. (See figures 9 and 10.) If the relief valve set point is lower than the system operating pressure, it will continuously vent gas to the atmosphere, thus wasting gas and possibly creating a hazardous condition.

When natural gas escapes through the vent line, the rain cap and attached flag move as one unit to the open position. When the escape of gas ceases, the rain cap returns to its normal horizontal position (closed over the vent line), but the flag stays down, thereby indicating that natural gas has been released through the vent line. The flag must be reset by hand to its normal vertical position. (See figures 11 and 12.) According to the gas serviceman who shut off the relief valve at station No. 1 on the day of the accident, the flag was down and "it appeared that it had worked at some time."

Station No. 1 was equipped with a Fisher-type 298K, 2-inch, double V-port regulator with two lines. One line, the loading line, was connected to the high pressure gas main (50 psig), and the other line, the control line was connected to the low pressure gas main (0.40 psig). Accordingly, if the low pressure control line ruptured, the regulator would sense atmospheric pressure through the ruptured line and open fully in an attempt to maintain its set pressure. This would allow gas at a high inlet pressure to enter the low-pressure distribution system. On the other hand, if the high pressure loading line ruptured, the regulator would close.

Pressure recording charts at each station continuously register the pressure in the high and low-pressure systems. The high and low pressure charts for station No. 1, indicated a sudden increase in pressure in the low pressure distribution system at the time of the accident. At 10:30 a.m., the pen on the low pressure chart recorded a maximum pressure of 15 inches W.C., and then ran off the chart. (See appendix B.) At the same time, the pen on the high pressure chart recorded a sudden decrease in pressure from 47 to 40 psig. When the pressure regulator was shut off, the pen recorded an increase in pressure to 50 psig. (See appendix C.) The pressure recordings at the regulator stations are not telemetered to the dispatcher's office in Mexico, Missouri, or to the central dispatching office in Moberly, Missouri.

^{2/} Section 9/49, Monitors, of the Gas Engineers Handbook, defines monitor regulator stations as "Installations consisting of two regulators installed in series, with the control point for both regulators, are called monitored regulator settings. The monitoring regulator is set slightly above (in some cases as little as 1.0 in W.C. over district pressure) the downstream pressure; thus it remains open and does not come into operation except upon failure of the main regulator."

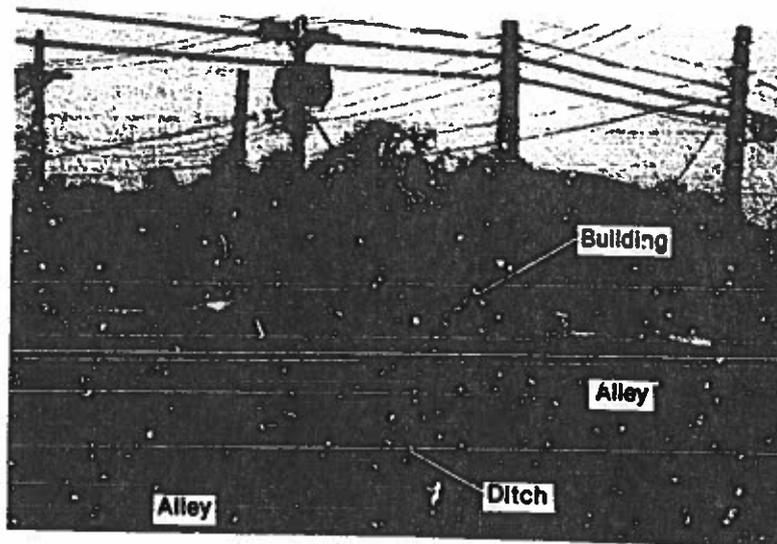


Figure 6.--District regulator building station No. 1.

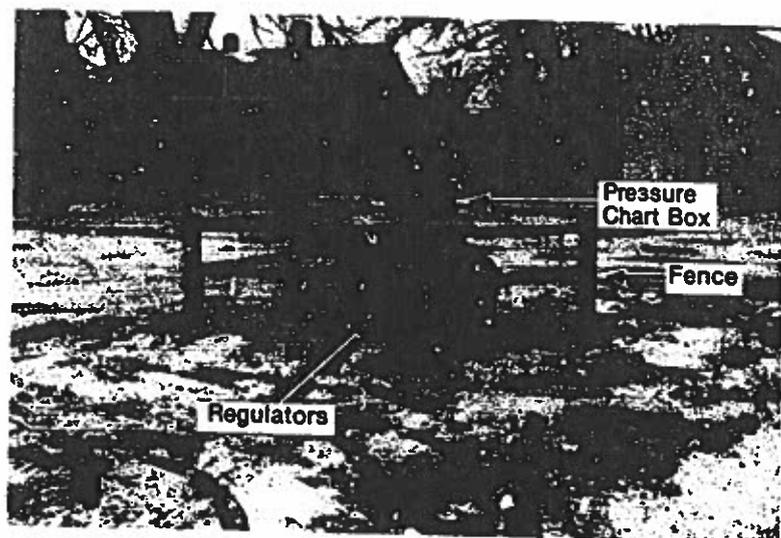


Figure 7.--District monitoring regulator station No. 3.

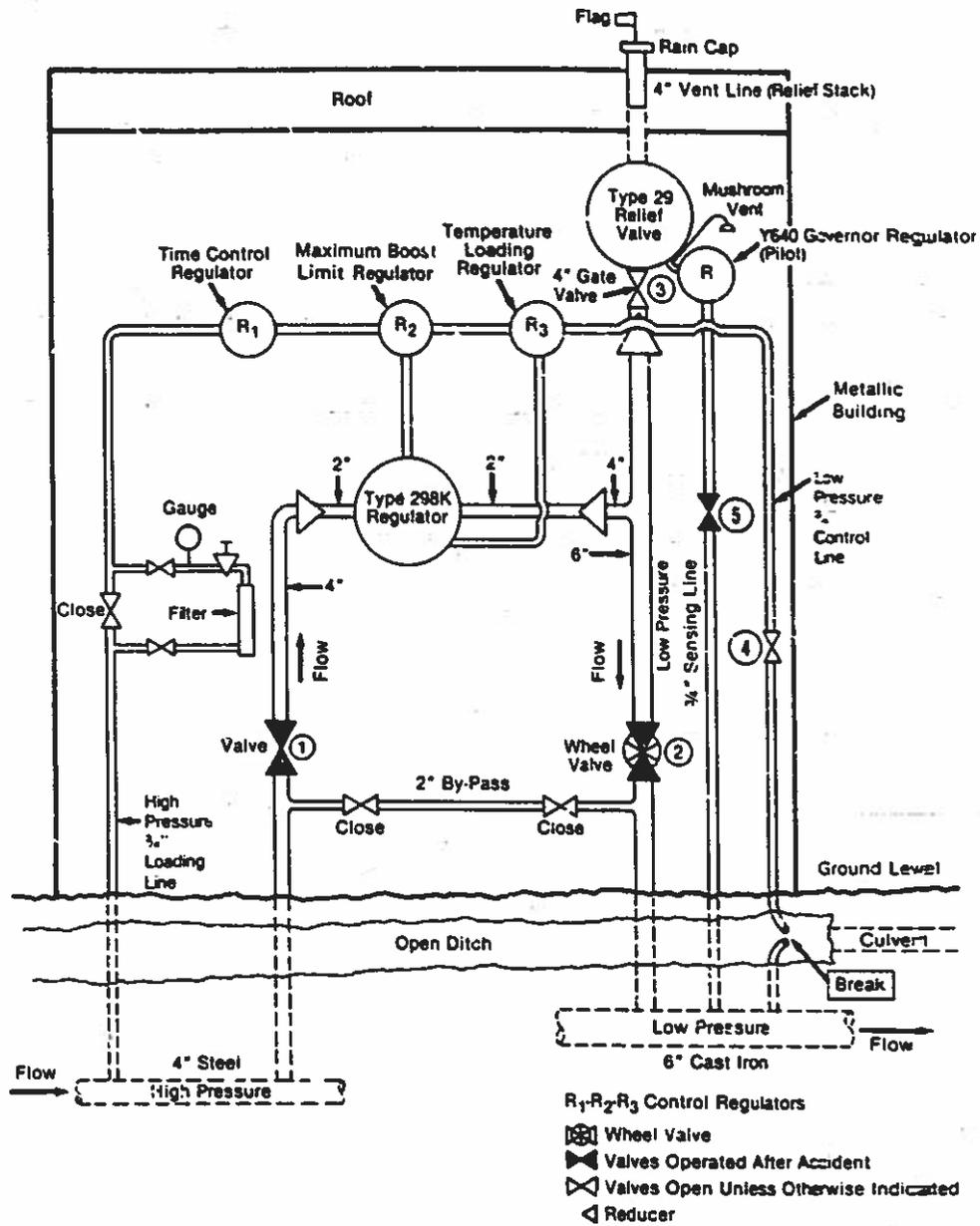


Figure 8.--Schematic of district regulator station No. 1.

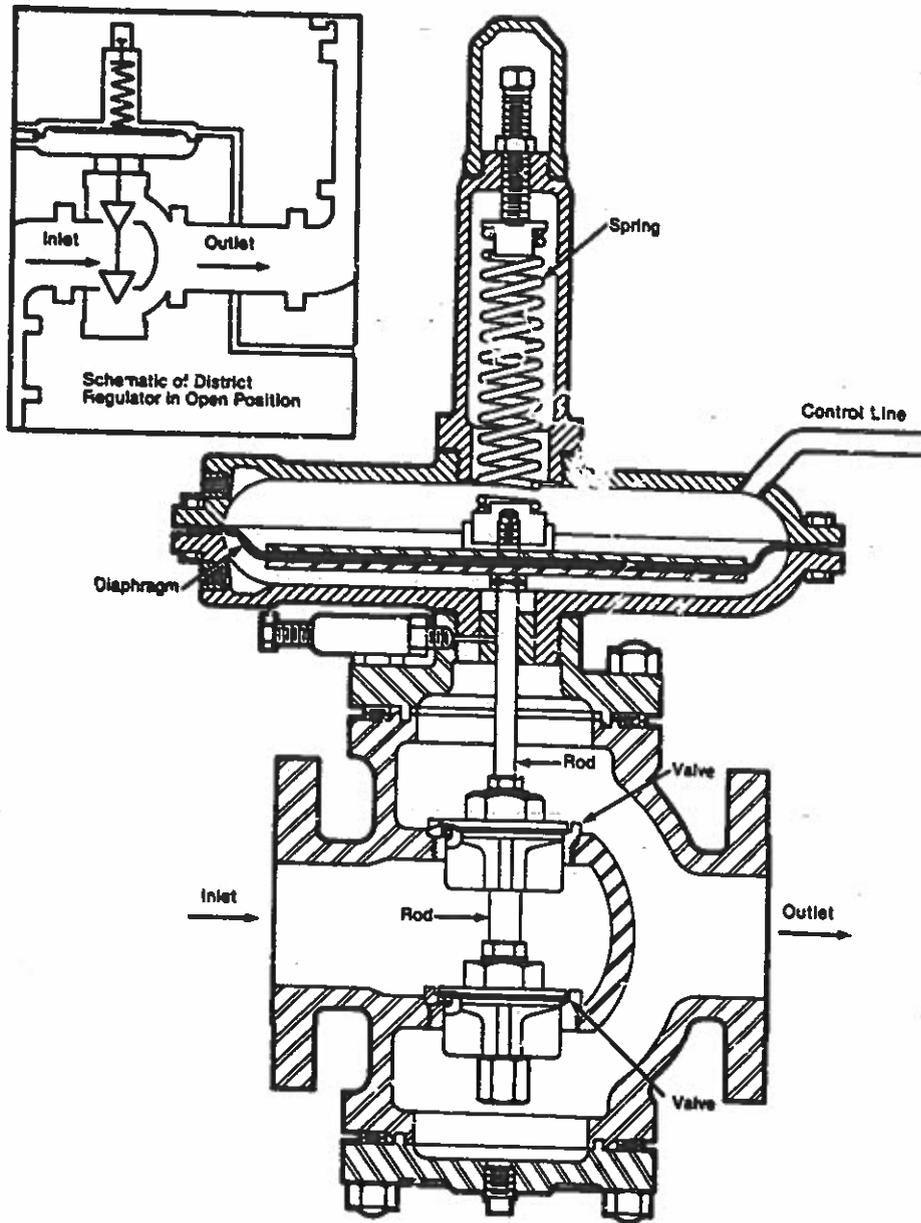


Figure 9.--Fisher controls type 298K, 2-inch double V-port gas regulator in closed position.

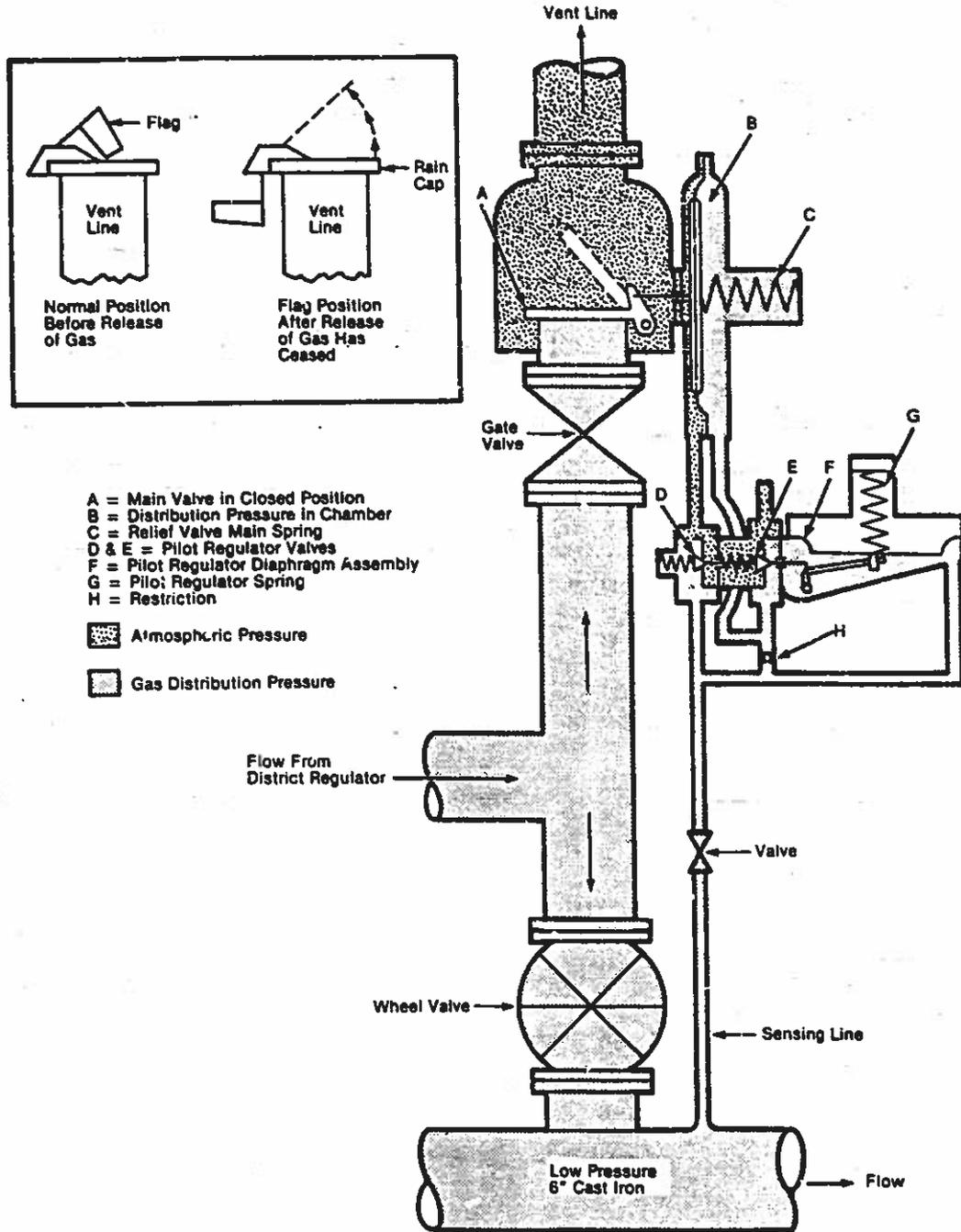


Figure 10.--Schematic of Fisher controls type 29, 4-inch pilot controlled relief valve in closed position.

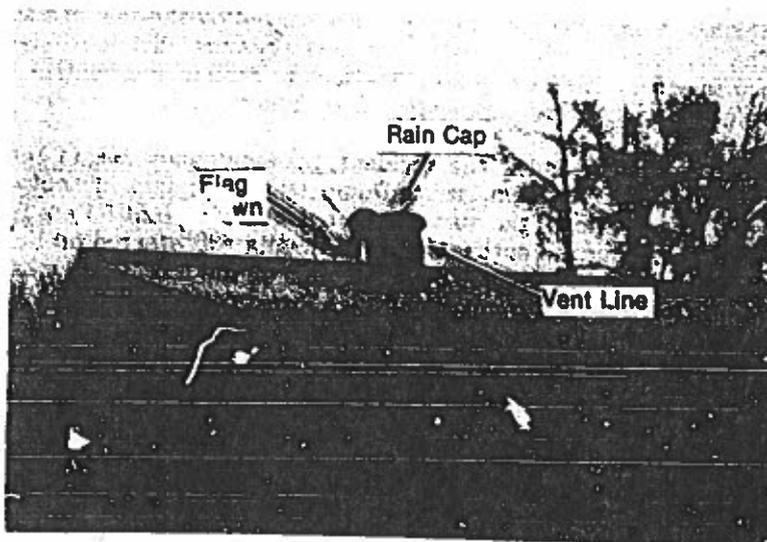


Figure 11.--Vent line, rain cap, and flag (down) after release of gas at regulator station No. 1.

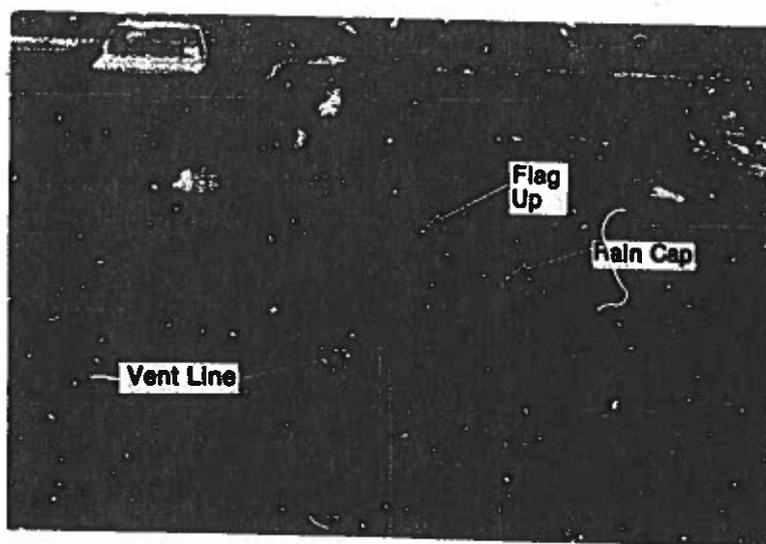


Figure 12.--Vent line, rain cap, and flag (up) before release of gas at regulator station No. 1.

The gas company in Centralia serves 1,558 residential, commercial, industrial, and municipal customers. Some 835 gas customers are served by the low pressure distribution system. ^{3/} The customers connected to the low pressure distribution system depend exclusively upon the four district regulator stations to reduce and control the natural gas pressure entering their houses and businesses. (See figure 14.)

About 8:30 p.m., on the day of the accident, gas servicemen began conducting a leak survey of the low pressure system, using flame ionization leak detectors. ^{4/} Due to unfavorable weather conditions, the survey was not complete until February 3, 1982. A second leak survey covering the entire city of Centralia was started on February 3, 1982, and was completed on February 22, 1982. As a result of the leak surveys, six leaks on the low-pressure system were found and repaired. Two other leaks, as a result of water blockage in mains on the low pressure system, were found and repaired; none of the leaks, were major nor did any contribute to the accident.

On February 1, 1982, the gas company installed a temporary monitor regulator station adjacent to station No. 1. The temporary station contained two regulators operating in series to provide pressure regulation and overpressure protection. Separate control lines for each of the two regulators were installed at that time to reduce the risk of excavation damage.

Survival Aspects

Hospitals were immediately notified of the accident and an emergency civil defense center was set up in the area. Greater damage probably would have resulted if it had not been for the actions of firefighters, policemen, civil defense personnel, gas company personnel, and residents who ran from building to building shutting off the gas at the meters, breaking windows, opening doors to allow the gas to escape into the atmosphere, and assisting in the evacuation of the occupants. The gas company had previously trained and authorized the Centralia's volunteer fire department personnel to close valves or shut off gas meters in case of emergency. However, the re-opening of valves and restoration of gas services are strictly reserved for gas company personnel.

Training

Training for appropriate operating personnel is required by 49 CFR 192.615(b)(2). Supervisory personnel (managers, superintendents, and supervisors) are required to attend technical courses offered annually by institutions, such as the University of Oklahoma in Norman, Oklahoma. Supervisors provide on-the-job training and instructions for appropriate nonsupervisory personnel.

During on-the-job training for nonsupervisory employees, a trainee works alongside an experienced worker or supervisor and learns by experience. There are no formal written tests given to the trainee, and after several months of on-the-job training, the trainee is allowed to go and perform certain duties without supervision if the trainee has shown he can perform the job to the satisfaction of his immediate supervisor.

^{3/} The remaining 723 gas customers are served by a 5 psig medium pressure distribution system with individual service regulators located next to each gas meter. The customers served by the medium pressure distributing system were not involved in the accident or subsequent fires. (See figure 13.)

^{4/} A flame ionization leak detector is a portable unit designed to detect natural gas in the air. It is lightweight and can be carried by one person who, on the average, can survey 8 miles, or 230 services per day.

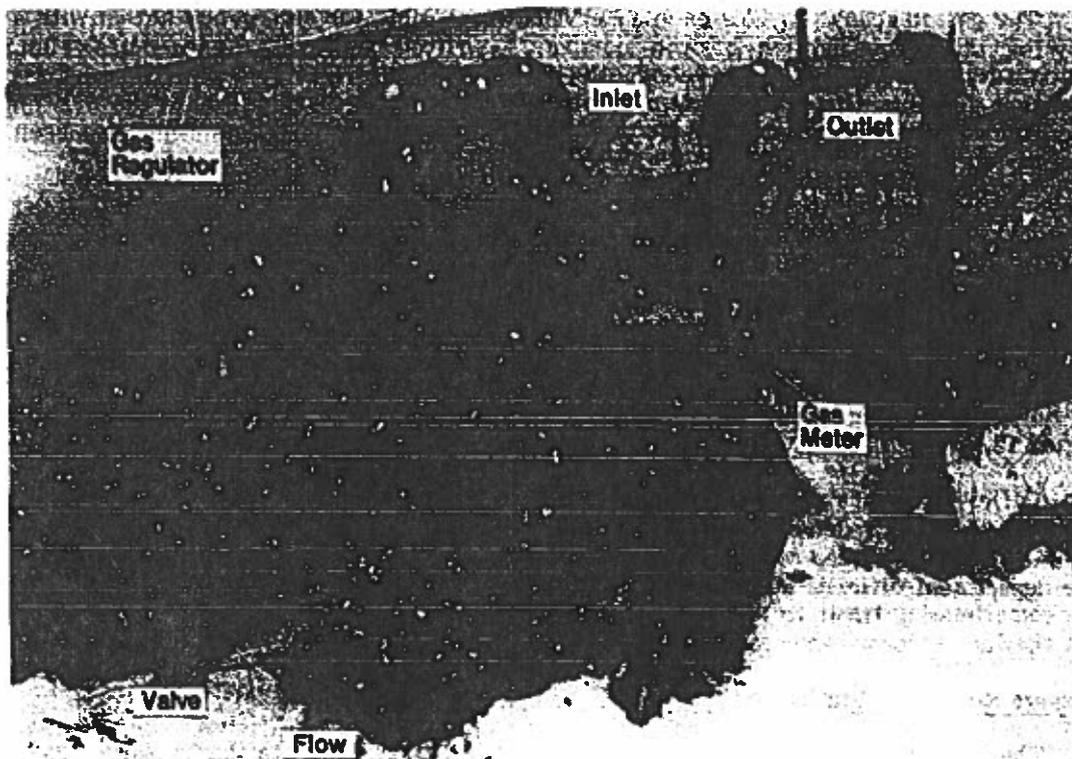


Figure 13.--Medium pressure meter set with individual regulator.

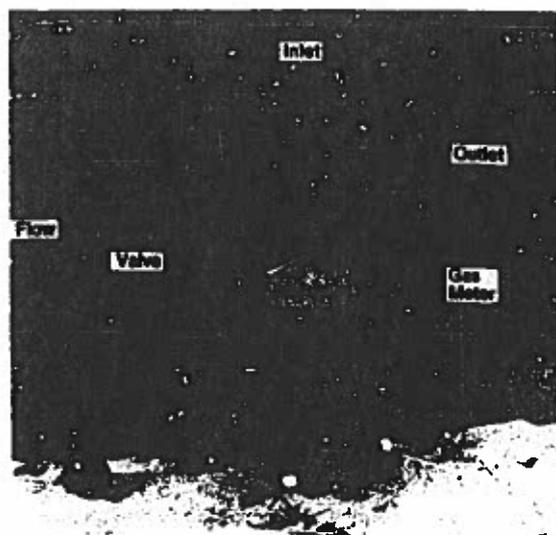


Figure 14.--Low pressure meter set.

The gas company provides each supervisor responsible for emergency action with a copy of the latest edition of the company's written emergency procedures plan. Periodically, training sessions are conducted at the district offices by the manager of gas operations to insure that appropriate operating personnel are knowledgeable in the written emergency procedures. Various Safety Board pipeline accident reports have also been discussed at these sessions.

A review of the gas company's emergency plan revealed that gas company officials were expected to visit city and county officials annually to discuss gas related emergency operations and to offer company sponsored training. Centralia's city officials stated that a check with current and retired personnel indicated that no gas company officials had been to City Hall to discuss emergency operations or gas company sponsored training. However, gas company records indicated that a gas safety program for the Centralia Fire Department had been held on May 1, 1980. Gas company records also indicated that the gas company's district manager attended a meeting with the Centralia City Council on August 10, 1981.

Officials of the Centralia Volunteer Fire Department stated that on several occasions they had received gas safety training from the gas company; however, the fire department did not keep records of the dates and items covered in the training sessions. Fire department officials said that because most of the volunteers hold full time jobs, it was sometimes difficult to have the entire volunteer force together; however, they felt that they are prepared and ready to fight any type of emergency.

Pressure Regulating Station Designs

The original station No. 1 was replaced with the existing station in April 1957. Before August 12, 1968, there were no Federal safety regulations for distribution and transmission gas pipelines within the continental United States. On November 13, 1968, the Office of Pipeline Safety, currently the Materials Transportation Bureau (MTB), Research and Special Programs Administration of the U.S. Department of Transportation, published the first set of Federal regulations, in Title 49 Code of Federal Regulations, Part 190, Interim Minimum Federal Safety Standards for the Transportation of Natural and Other Gas by Pipeline.

The American Standards Association (ASA) Gas Transmission and Distribution Piping System, ASA B31.8 1955 Edition was in effect at the time the regulator at station No. 1 was installed. The code which was not mandatory, but was followed by most gas companies, contained the following information on the "Requirements for Design of All Pressure Relief and Pressure Limiting Installations:

845.66 (a) When a monitoring regulator, series regulator, system relief or system shut-off, is installed at a district regulator station to protect a piping system from overpressuring, the installation shall be designed and installed to prevent any single incident such as an explosion in a vault or damage by a vehicle from affecting the operation of both the overpressure protective device and the district regulator.

(b) Special attention shall be given to control lines. All control lines shall be protected from falling objects, excavation by others, or other foreseeable causes of damage and shall be designed and installed to prevent damage to any one control line from making both the district regulator and the overpressure protective device inoperative. (emphasis added)

The current code, American National Standards Institute (ANSI) B31.8, contains the same information.

Title 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline, effective 1971, states in part:

192.203 Instrument, control, and sampling pipe and components.

* * * * *

(b)(9) Each control line must be protected from anticipated causes of damage and must be designed and installed to prevent damage to any one control line from making both the regulator and the overpressure protective device inoperative.

Pressure Regulator Station Inspections

The gas company performed its last Gas Regulator Station-Pressure Relief, Annual Inspection and Check at station No. 1 on September 8, 1981. The inspection report indicated that the valve in the relief line was "turned off." (See appendix E.) Gas company records also indicated that on September 9, 1981, an inspection had been performed at Station No. 4 and its relief valve also was "turned off." The records indicated that the valve in the relief lines at both regulator stations had not been "... left locked in open position."

The gas company serviceman who made the last inspection at station No. 1 before the accident said that he turned the relief line valve off, and that the valve was out of service for about 2 hours. He said that he believed that the assistant district superintendent adjusted the relief valve and then turned on the relief line valve. The assistant district superintendent stated that he had cleaned the relief valve to make it leak free and then had turned the relief line valve on, but no written report was ever filed for this work. On the other hand, the inspection records for the previous four annual inspections (1980, 1979, 1978, and 1977) indicated that the relief valve for station No. 1 had been turned off or not checked. Previous inspection records for the same 4 year period for station No. 4 indicated that its relief valve also had been turned off, or had not been checked. Before the accident, the gas company had planned to replace station Nos. 1 and 4 with monitoring stations similar to station Nos. 2 and 3.

The gas company does not keep records or detailed blueprints, maps, or schematic diagrams of regulator station No. 1 which would indicate the exact location of the various connections of its piping to the high and low pressure mains. To find the connections, gas company personnel must excavate the area. The drawing of the regulator station (see figure 8) was made by the Safety Board's investigator-in-charge based on his inspection of the station.

Test and Research

On February 3, 1982, the Safety Board conducted in-place tests of the relief valve at regulator station No. 1. Representatives of the Materials Transportation Bureau of the U.S Department of Transportation, the Missouri Public Service Commission, the city of Centralia, and the Missouri Power and Light Company attended the tests.

Before the tests were initiated, the relief valve vent line was examined. The rain cap and flag operated freely; however, cobwebs were found on the rain cap hinge housing and rust and debris were found inside the vent line on top of the relief valve.

A test was made to check the operation of the rain cap and indicator flag. A pressure of 5 psig was introduced into the vent line downstream of the relief valve; the rain cap partially opened and chattered. The pressure was then increased between 30 and 33 psig and the rain cap opened fully and the indicator flag tripped.

Another test was made to check the operation of the relief valve. Gas pressure was slowly fed into the inlet side of the relief valve, and at 9 inches W.C. (0.33 psig), both the relief valve and the rain cap started to open. Gas pressure to the inlet side of the relief valve was then increased to 13 inches W.C. (0.47 psig) and the relief valve opened fully. The tests were repeated again for verification and the same results were obtained. (See appendix D.)

After tests were completed, the vent line and its rain cap were again examined. The rust and scale had been blown out and the spider web on the rain cap hinge housing had been blown away partially by the discharge of natural gas through the vent line during the test; the metal building housing the regulator facilities was then padlocked.

A second in-place test was conducted to duplicate more accurately the conditions of gas pressure and gas flow which existed at the time of the accident. In addition to the representatives who witnessed the first tests, representatives of the Panhandle Eastern Pipe Line Company and the Fisher Controls Company attended the test. During the test, the full gas pressure of 48 psig was slowly introduced into the regulator valve and the relief valve; the regulator valve and relief valve operated properly. Next, a regulator control line rupture condition was simulated; the regulator opened wide (failed open) and the relief valve vented the excess gas pressure to the atmosphere; all equipment operated as designed. (See appendix D.)

Other Information

Centralia, Missouri, population 3,500, is located approximately 20 miles northeast of Columbia, Missouri. Centralia's streets lack sidewalks except for a few streets (about 10 percent) leading to the main square. The gas service lines which extend from the gas mains to the buildings of individual customers pass under small drainage ditches at the edges of the roads. During the fall and winter months the ditches are cleaned by the city, using mechanical equipment or picks and shovels to remove leaves, ice, and snow.

The foreman said that he had cleaned the ditch involved in the accident with the same type of equipment 2 years before the accident and had not experienced any problems. He also said that he thought it was a low pressure service line because he had hit about 10 service lines during his 21 year's employment with the city. Following these incidents, none of which resulted in an accident, he shut the gas off at the house meter and called the gas company to make repairs. The foreman and city officials stated that "the job was not excavation work" and added that "when excavation operations are involved," they "immediately contact the gas company for location of underground facilities."

The Missouri Statute, Chapter 319, General Requirements, Section 319.015(1) states, in part:

"Excavation" means any operation in which earth, rock or other material in or on the ground is moved, removed or otherwise displaced by means of any tools, equipment or explosives and includes, without limitation, grading, trenching, digging, ditching, drilling, augering, tunnelling, scraping, cable or pipe plowing, driving, and demolition of structures."
(emphasis added)

Also, Section 319.025 of the same statute states:

Excavator must give notice and obtain information, when, from whom.-A person shall not make or begin any excavation in any public street, alley, right-of-way dedicated to the public use or easement without first giving notice to and obtaining information from each and every public utility, municipal corporation or other person having such underground facilities within the public street, alley, right-of-way or easement, concerning the possible location of any underground facility.

No central system for excavation notification, which allows excavators to give early notification to underground utility operators, exists in most of the State of Missouri. One-calls ^{5/} notification systems currently operate in all or part of 46 States with more than half providing statewide coverage; however, the recently initiated one-call system operating in the State of Missouri provides service only in the Springfield area.

Data based on accidents reported under 49 CFR Part 191, Transportation of Natural Gas by Pipeline; Report of Leaks, to the Materials Transportation Bureau of the U.S. Department of Transportation, indicate that outside force damage caused by excavation activities is the primary cause of pipeline failure.

The State agents of MTB periodically inspect gas operator facilities within their jurisdiction to determine if operators are in compliance with 49 CFR Parts 191 and 192, Regulations for the Transportation of Natural and Other Gas by Pipeline. These periodic inspections include in part: Emergency plans (192.615), Valve maintenance (192.747), General provisions (192.603(b)), Pressure limiting and regulating stations: inspection and testing (192.739), Pressure limiting and regulating stations: testing of relief devices (192.743), and Protection against accidental overpressuring (192.195).

ANALYSIS

General

A number of factors tend to explain why the foreman was unaware of the presence of the control line in the vicinity of district regulator Station No. 1: (1) he could not see the control line because it was located about 12 inches below the bottom of the ditch, (2) he had cleaned the same ditch with the same type of equipment 2 years before the accident and had not experienced any problems, (3) he had not received any briefings about the location of the underground gas lines, and (4) neither the gas company nor the city had provided the foreman with blueprints or diagrams of piping to or from the various regulator stations, or for any other gas lines throughout the city. The exact locations of

^{5/} A one-call system is a communication system established by two or more agencies or companies to provide one telephone number for excavation contractors, utilities, public agencies, and private citizens to call and notify operators of underground facilities of their intent to use equipment adjacent to these facilities for the purpose of excavating, tunneling, demolition, boring, blasting, etc.

the underground control line and sensing line were not marked or staked because the city had not asked the gas company to do so. However, the lack of records or detailed blueprints, maps, or schematics for station No. 1 would have made it difficult for gas company personnel to mark or stake the exact location of the control line.

The Safety Board's review of the annual inspection reports for regulator station No. 1 indicated that during the 5-year period before the accident the regulator station's relief valve had been variously turned off or not checked. The annual inspection reports for the regulator station had been filed and never reviewed or studied by gas company management and, thus, the fact that the relief valve had been isolated was not known to management, nor did it know why it was isolated, or why any deficiency was not immediately repaired, or what the consequences might be of leaving the valve isolated. Because such analysis of these inspection records was not routinely performed, gas company management was not alerted to the fact that the overpressure protection for the low pressure system in Centralia had been nullified. The serviceman who performed the last annual inspection for station No. 1 said that he reported the position of the relief valve to his supervisor; however, no records exist to indicate what action the supervisor took to rectify the situation. If, at the time of the control line rupture, the relief valve had been in the open or operational position, this accident would have been avoided because the high pressure gas would have been vented to the atmosphere through the relief valve's vent line and the low pressure distribution system would have been protected from overpressure.

The loading and sensing lines for the regulator were attached to the high and low pressure piping, respectively, outside the metal building and were, therefore, vulnerable to damage from excavation operations. Although no Federal regulations for the design and installation of regulator stations were in effect when station No. 1 was built in 1957, industry standard ASA B31.8 was in existence. The Missouri Power and Light Company should have installed the regulator station according to the standard, which is a recommended guide and not a mandatory practice. If the regulator station had been installed according to B31.8, precautions would have been taken to protect the control lines and this accident would not have happened.

If the pressure readings at the four regulator stations in Centralia had been telemetered to the dispatching center in Moberly, which is manned 24 hours per day, and if the station had been connected to an alarm, the abrupt increase in pressure in the low pressure system and the rapid pressure drop in the high pressure system (47 to 40 psig) would have immediately alerted the dispatcher to the overpressure condition in the low pressure distribution system. He could have sent a service line worker to the regulator station to shut it down. As it was, the scattered reports he received from customers did not immediately identify the problem. Although telemetering of pressures to a central manned office is not a Federal regulatory requirement, it is used in systems similar to the one serving Centralia. Had it been used in this instance, the overpressure problem would have been identified earlier which would have allowed the company to implement prompt, direct action.

The Safety Board has previously made recommendations to the Missouri Power and Light Company concerning the use of telemetered equipment. On January 8, 1981, the Safety Board investigated a 2-inch-diameter gas main which pulled apart at a compression coupling in downtown Mexico, Missouri. Natural gas at 43 psig escaped and was ignited in a nearby building. The explosion and fire destroyed the building, damaged an adjacent building, broke windows, and damaged several vehicles. There were no fatalities; however, three firefighters were injured while fighting the fire.

The increased rate of flow that occurred when the coupling failed was shown at that time on the telemetered gas pressure and rate of flow chart at the then unmanned Missouri Power and Light Company's service center. As a result of its investigation the Safety Board recommended that the Missouri Power and Light Company:

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

The Safety Board has not yet received a response from the company.

Regulator Station

When the backhoe bucket snagged and broke the pressure regulator control line, the regulator, in an attempt to hold the 11 inch W.C. (0.40 psig) and satisfy what the regulator sensed to be a demand for additional gas, opened wide. The wide open position of the regulator allowed gas at 47 psig to enter the low pressure system and overpressure the system. When the overpressure occurred, some pilot lights were blown out, permitting gas at high pressure to fill buildings. In other buildings where the pilot lights did not go out or furnaces or stoves were in use, the gas flames intensified and burned flammable building materials within the structures.

The district regulator station had a relief valve in series with the regulator to protect against overpressuring the downstream, low pressure distribution system. When a relief valve senses an overpressure, it automatically opens and relieves the pressure on the downstream distribution system by venting the excess gas into the atmosphere. If the overpressure is small and transient the relief valve opens momentarily to vent the excess gas. If the over pressure is large and continuous, the relief valve opens wide and continues to vent the excess gas through the vent line until corrective action is taken.

Tests after the accident showed that the relief valve opened properly at its low pressure set point. However, debris was found in the vent line before the test and was blown out in the course of early parts of the test. Based on a review of the gas company's records, it was determined that the relief valve had been turned off during an inspection on September 8, 1981, and entered as such on the inspection form; there was no entry stating that the valve had been returned to operation.

The in-place test results indicated that the relief valve was in good working order. However to operate properly, a relief valve must have the valves open on the inlet side (valve No. 3) and on the sensing line (valve No. 5). Since the valve failed to operate following the rupture of the control line, either the gate valve (valve No. 3) under the relief valve or the plug valve (valve No. 5) in the sensing line must have been closed.

From the in-place test, the Safety Board determined that the relief valve's governor regulator was set at 9 inches W.C. (0.33 psig) pressure at the time of the accident. The pressure on the low pressure system was about 11.5 inches of W.C. (0.41 psig). These conditions would have resulted in the continuous release of gas through the relief valve if it were operational and would serve to explain why the valve had been isolated.

At the time of the accident, the district gas regulator failed in a wide open position which increased the flow and pressure of gas into the low pressure distribution system. The gas flow entering the low pressure system was indicated on the charts at Panhandle's

Town Border Station at 65.63 Mcf/hour. 6/ The Fisher-type 29 relief valve installed at station No. 1 had a capacity of 84 Mcf/hour at an outlet pressure of 14 inches of W.C., which is 18.37 Mcf/hour greater than the entire flow entering the low pressure system. The relief valve had more than adequate capacity to handle the increase load and maintain a safe downstream pressure; however, because the relief valve had been isolated before the accident, it was in effect inoperative and the low pressure distribution system was subjected to an initial pressure approximately 100 times greater than it was designed to handle.

Excavation Damage Prevention

Even though the city officials and the street-foreman believed that the ditch cleaning operations did not constitute excavation, the Safety Board believes that the Missouri Statute clearly included this type of operation within its definition of the term "Excavation" and intended that notification of such operations be provided to operators of underground facilities.

Even absent of any statutory requirement for action to prevent damage to underground facilities, there continues to exist an urgent need for the city and the gas company to take action for the prevention of excavation damage to the underground gas system because of the numerous gas service lines crossing under city drainage ditches. The potential for the city's ditch cleaning operations to damage the gas pipeline system has existed for years and, as verified by the city's foreman, such operations have on several occasions damaged the gas system. Since these incidents never resulted in a gas accident, the foreman was never particularly concerned. He considered these incidents to be unimportant and he did not realize the potential for a major accident. However, neither the city nor the gas company acted to inform the city employees about the potential consequences of damaging the underground gas piping system, or to assure that pipelines in the vicinity of proposed excavations were located and marked before work was begun. Had such actions been taken before this accident, the city's foreman would have been aware of the location of the pipeline, and could have been briefed about the types of facilities which existed in the path of the proposed cleaning operations. Had the city foreman been provided with this information, it is doubtful that mechanized equipment would have been used at this location to perform the work.

Had a one-call system been in operation in Centralia before the accident, the city's task in giving notice of proposed excavations to the gas company and other underground facility operators would have been simplified; but of greater importance, the "one-call" system could have reinforced the Missouri Statute through educational and promotional efforts to acquaint excavators and operators with the purpose of the system and the importance of damage prevention measures. Experience with existing "one-call" systems shows that they serve to focus the damage prevention efforts of all underground facility operators, including those operated by government agencies, into a more effective and less costly damage prevention program, motivate increased cooperation between excavators and operators of underground facilities, and provide an effective means for disseminating information about applicable laws and regulations. As previously stated by the Safety Board, 7/ "The effectiveness of any program to prevent damage to pipelines depends on many separate but interrelated factors. A program which does not address all factors can only be partially effective." At the time of this accident, only one of the factors considered necessary for an effective program existed -- Missouri Statute Chapter 319.

6/ 1 Mcf equals one thousand cubic feet.

7/ Special Study, "Prevention of Damage to Pipelines," NTSB-PSS-73-1, June 7, 1973, p. 7.

CONCLUSIONS

Findings

1. The rupture of the pressure regulator control line in district regulator Station No. 1 caused the regulator to open wide and discharge 47 psig gas into the 0.40 psig distribution system.
2. The relief valve at district regulator Station No. 1 did not provide the intended protection for the low pressure gas system because it had been isolated by a valve which was closed at the time of the accident. The lack of protection against overpressurization allowed high pressure gas to enter the low pressure distribution system, resulting in fires ignited by high pilot lights and appliance flames and the release of gas into buildings where pilot lights were blown out.
3. The pressure regulator control line, which was buried under a drainage ditch with only 12 inches of ground cover, was unprotected against excavation damage.
4. The relief valve, vent line, and rain cap were in proper operating condition when in-place tests were performed.
5. The relief valve had sufficient capacity to handle the increased volume of natural gas introduced when the control line was damaged.
6. The presence of extensive cobwebs, debris, and rust inside the vent lines before the in-place tests were conducted and the disappearance of the debris and rust and displacement of the cobwebs after the test had been completed, confirmed the fact that the relief valve did not operate at the time of the accident.
7. With the relief valve of Station No. 1 set at 9 inches of W.C. (0.33 psig) and the regulator providing gas into the low-pressure distribution system at 11 inches of W.C., (0.40 psig), the relief valve would have been venting natural gas continuously. This would tend to explain why the relief valve had been isolated.
8. The last inspections performed by the gas company at stations Nos. 1 and 4 on September 8 and 9, 1981, respectively, indicate that the relief valves were isolated from the system. Gas company records did not indicate that the relief valves had been returned to operation.
9. Although the State of Missouri Statute requires that an excavator must contact a utility company before any excavation begins, the city of Centralia failed to notify the gas company of its intent to excavate.
10. The volunteer fire department, police department, local civil defense, residents, and gas company personnel combined effectively to evacuate and maintain order in the affected area. This coordinated action effectively reduced the potential for a catastrophe.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the rupture of a pressure regulator control line by a city operated backhoe and the isolation by the gas company of a related relief valve which allowed natural gas at 47 psig to enter the low pressure distribution system, rather than to vent to the atmosphere. Contributing to the accident was the failure of city officials to notify the gas company of its excavation operations and the failure of the gas company to take prompt action to adjust the relief valve and restore it on line.

RECOMMENDATIONS

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

--to the American Gas Association:

Notify its member companies of the circumstances of this accident and urge them to inspect their regulator station relief valves or other overpressure protection equipment to make sure that they are set properly and operating properly. (Class II, Priority Action) (P-82-30)

--to the Research and Special Programs Administration of the U.S. Department of Transportation:

Direct its regional field office personnel and State agents to include in their inspection of regulator stations a determination of whether the relief valves are properly set and are operational and whether the control lines are protected against excavation damage. (Class II, Priority Action) (P-82-31)

--to the Missouri Power and Light Company:

Implement a procedure for the systematic review of inspection records to assure that unsafe conditions noted by inspectors are promptly corrected. (Class II, Priority Action) (P-82-32)

Conduct an inspection of all of its district regulator stations system-wide to determine if all relief valves and control sensing line valves are in their correct positions and if the regulator station control lines are adequately protected against excavation damage and take corrective action as necessary. (Class II, Priority Action) (P-82-33)

Review its maps and records of district regulator station piping to determine their accuracy and completeness and take appropriate action where necessary to correct these documents. (Class II, Priority Action) (P-82-34)

Establish a public awareness program for the prevention of excavation caused damage to underground facilities and support the establishment of a "one-call" notification system in its area of operation. (Class II, Priority Action) (P-82-35)

Install equipment to transmit gas pressure or gas flow data from district regulator stations in Centralia to the dispatcher at Moberly, Missouri, with alarms to alert the dispatchers in the event of abnormal gas flow rates or pressures. (Class II, Priority Action) (P-82-36)

-- to the Governor of the State of Missouri and to the Missouri Public Service Commission:

Encourage operators of underground facilities to develop and implement a statewide one-call excavation notification system. (Class II, Priority Action) (P-82-37)

--to the City of Centralia, Missouri:

Require city officials to give notice to all underground and above ground utilities of any planned excavation work to be performed for the city by a city employee or a private contractor. (Class II, Priority Action) (P-82-38)

Instruct the city's excavation equipment operators not to commence excavation activities until they have determined the specific location of underground utility lines in the area. (Class II, Priority Action) (P-82-39)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G.H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

PATRICIA A. GOLDMAN, Vice Chairman, did not participate.

August 24, 1982

APPENDIXES

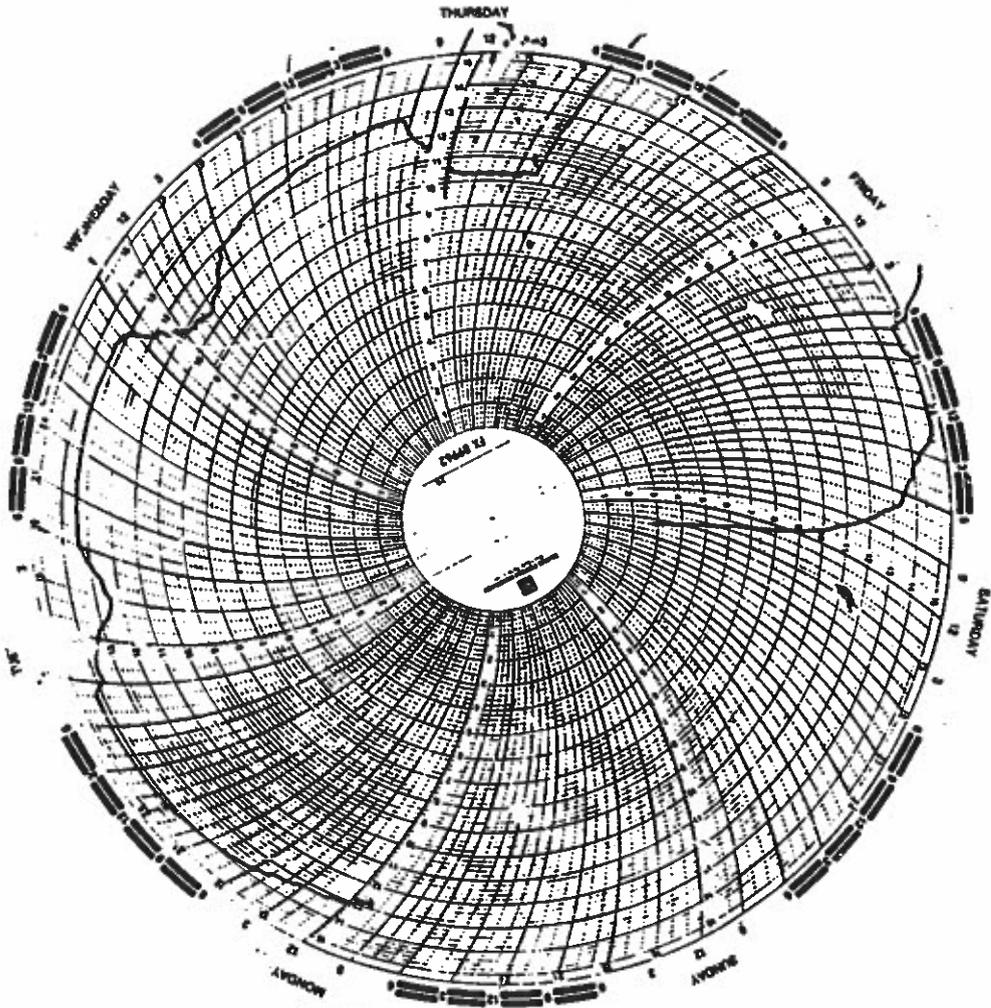
APPENDIX A

INVESTIGATION

The National Transportation Safety Board was notified of the accident at 4:02 p.m., on January 28, 1982. Early on January 29, 1982, the Safety Board dispatched an investigator from its Washington, D.C. headquarters to the accident site. Upon arrival at the scene, the Safety Board investigator took charge of the investigation.

APPENDIX B

DISTRICT REGULATOR
STATION NO. 1
(LOW PRESSURE CHART)



CU B RIVER - DISTRICT REGULATOR	
DATE	10-27-22
TIME	10:30 AM
BY	DL

APPENDIX D

**TEST PERFORMED ON FEBRUARY 3, 1982
REGULATOR STATION NO. 1**

TEST NO. 1

Employees from the Missouri Power and Light Company (gas company) installed a 1/4-inch copper line from a plug valve on the high-pressure side of the system (50 psig) to the exhaust side of the relief valve body. (See attached schematic for test No. 1.) This part is located on the atmospheric side of the relief valve. The temporary copper line was equipped with a shutoff valve for control and a tee with a gauge installed on it. Valve Nos. 1, 2, 3, 4, and 5 were closed. A pressure of 5 psig was introduced through the copper line into the exhaust side of the relief valve body. This test was to clear the vent line on the outlet side of the relief valve and check operations of the rain cap and indicator flag. At 5 psig, the rain cap partially opened and the indicator flag tripped.

TEST NO. 2

Gas company employees then installed a temporary 1/4-inch copper line from the plug valve on the high-pressure side of the system to the governor regulator sensing line. (See attached schematic for test No. 2). A low-pressure gauge (ounces-inches of W.C.) was also installed in the test location of the sensing line. The source of gas to the 298-K regulator was shut off; valves 1, 2, 3, 4 and 5 were in the closed position. Then, valve No. 2 was opened and the gate valve No. 3 under the relief valve was also opened. This operation permitted pressure from the low pressure side of the system to load the relief valve. Care was taken to keep valve No. 5 closed in order to isolate the test location from the downstream system. At this time, pressure on the low pressure side of the system was 11 inches of W.C. and this pressure was being supplied by a temporary monitor station installed a few feet from Station No. 1 after the accident.

The plug valve on the high pressure side was slowly opened and pressure was introduced into the governor regulator sensing line. The relief valve started to open at 9 inches of W.C. pressure and the rain cap was partially open. Pressure to the sensing line was increased to 13 inches of W.C. and the relief valve was fully open. Flow through the relief valve was audibly noticeable and the rain cap was fully open.

TEST NO. 3

The previous test was repeated to verify results. (See attached schematic for test No. 3.) The relief valve again started to open at 9 inches of W.C. pressure and was fully open at 12-13 inches of W.C. pressure. After the test, the plug valve on the high-pressure side was closed. The gate valve No. 3 under the relief valve was also closed. The governor regulator sensing line plug valve No. 5 was opened and again a pressure of 11 inches of W.C. was noted on the low-pressure test gauge. Plug valve No. 5 was closed again and the temporary copper line removed.

**TEST PERFORMED ON MAY 7, 1982
REGULATOR STATION NO. 1**

TEST NO. 4

Gas company employees installed a 20-foot 1/4 inch hydraulic hose from the plug valve on the high pressure side of the system to the governor regulator sensing line.

Valves Nos. 1, 2, 3, 4, and 5 were closed. (See attached schematic for test No. 4.) Pressure was introduced into the sensing line and the relief valves opened at 20 inches of W.C. This higher pressure was required to open the valve because the lower surface of the relief valve was not loaded; therefore, extra pressure was required to compensate for the relief valve's weight and spring loading.

Then, the gate valve No. 3 and valve No. 2 were opened. A 6 1/2 inches of W.C., pressure was applied to the sensing line and the relief valve did not open but the pilot regulator mushroom vent was venting gas to the atmosphere. Pressure was increased to 9 1/2 inches of W.C. and relief valve did not open but gas was still venting to the atmosphere through the mushroom vent.

TEST NO. 5

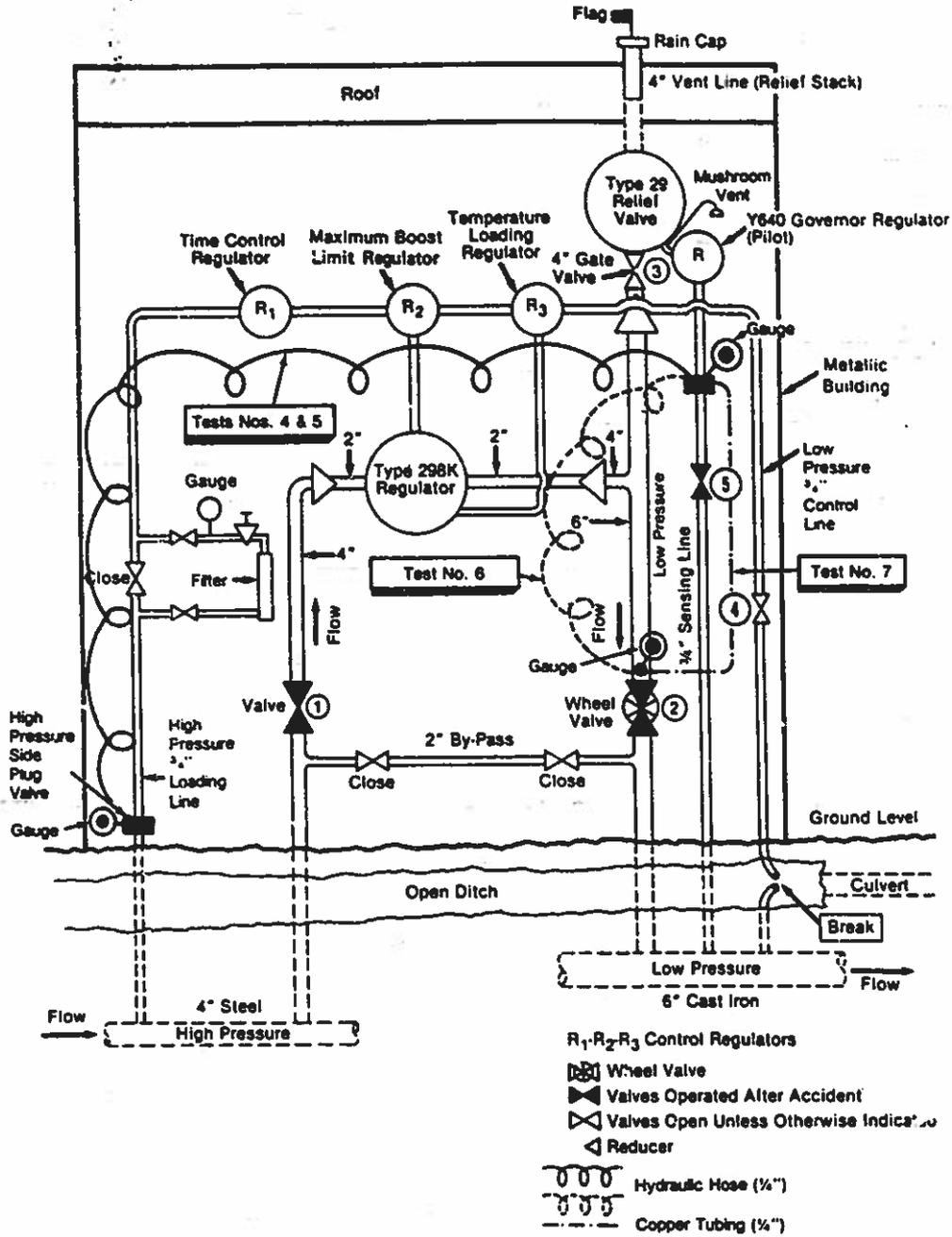
The boost on the Limit Regulator (R₂) was increased. Valve Nos. 1, 2, 4, and 5 were closed. Then, valve No. 4 was opened (this valve is located in the Downstream control line which was damaged on January 28, 1982, and since then, it has been open to the atmosphere). (See attached schematic for test No. 5.) Zero to 35 inches of W.C. gauge was installed in a tapped hole in the 6-inch low-pressure pipe just above valve No. 2. Another 0 to 35 inches of W.C. gauge was installed in the governor regulator sensing line. The plug valve on the high-pressure side was partially open to hold 15 psig pressure. The inlet pressure upstream of the 298-K regulator was 48 psig. Slowly, high pressure gas was introduced to the 298-K regulator by opening valve No. 1. The relief valve started to open at 8 1/2 to 9 inches of W.C., and was full open at, 13 to 15 inches of W.C. The gauge above valve No. 2 held at 20 inches of W.C. and the inlet pressure to regulator 298-K dropped to 45 psig.

TEST NO. 6

The hydraulic hose from the governor regulator sensing line was connected to the 6-inch low-pressure line tap above valve No. 2. (See attached schematic for test No. 6.) This replaced the high pressure gas source from the high-pressure side plug valve. Valves No. 2 and 5 were closed. Valve No. 1 was opened slowly and the relief valve started to open at 8 1/2 inches of W.C. The gauge on the 6-inch line above valve No. 2 read 35 inches of W.C. (turbulent but stable), and the gauge on the governor regulator sensing line read 15 inches of W.C. The difference in gauge readings was attributed to the excess length of hydraulic hose and hose fittings which resulted in line pressure drop under high flow conditions. During the test, the inlet pressure to the 298-K regulator dropped from 48 psig to 45 1/2 psig.

TEST NO. 7

The hydraulic hose was replaced by a 3/8-inch CTS x 13 foot long copper tube and connected from the 6-inch downstream line tap to the governor regulator sensing line. Fittings had full 1/4-inch bores. Keeping valve Nos. 2 and 5 closed, valve No. 1 was slowly opened and the relief valve started to open between 9 and 10 inches of W.C. and held at 35 inches of W.C. during full flow. The gauge above valve No. 2 stabilized at 38 inches of W.C., (very turbulent but stable.) During this test, the inlet pressure to the 298-K regulator dropped from 48 1/2 to 45 1/2 psig. After completion of the tests, valves No. 1, 2, and 4, 5 were left closed and the hydraulic hose and copper line were removed.



May 7, 1932 Test.

APPENDIX B
GAS REGULATOR STATION NO. 1,
PRESSURE RELIEF - ANNUAL INSPECTIONS AND CHECKS

Form No. 744-5
(11-71)

GAS REGULATOR STATION - PRESSURE RELIEF
ANNUAL INSPECTION AND CHECK

STATION #1. Tip Top TOWN Centralia

1. Regulator: Fisher 298A

A. Hand hole or inspection plate removed and interior of regulator examined for defective valve discs, valve seats and worn linkage (note results and action taken.)

B. Regulator vents free of obstruction? yes

C. Gauges working properly? yes but needs new clock

D. Inlet pressure 48 lb Outlet pressure 10.5"

2. Pressure relief valve or monitor regulator:

A. Relief valve or monitor tested? NO

Relief valve opened at? _____

Relief valve setting left at? _____

Monitor started to function at? _____

Monitor setting left at? _____

B. Relief vent free of obstruction? _____

C. Relief valve leaking through after test? _____

D. VALVE ON RELIEF LINE LEFT LOCKED IN OPEN POSITION? _____

3. Valves:

A. Plug valves lubricated? NO

B. By-pass line valves left in closed position? yes

C. All unhooded valves equipped with locking devices and locks? yes

1977 Annual Inspection and Check.

4. General:

- A. Piping and equipment tested for leaks? yes Results? OK
- B. Building or vault vents free of obstruction? yes
- C. Piping, equipment and building paint in good condition? needs paint
- D. Station and grounds free of combustible material? needs grass cut
- E. "DANGER - GAS" or "CAUTION - GAS" signs posted? yes
- F. Door on building or vault left locked? yes

REMARKS: Inspected station, 3 in gauges, could run
clock on low pressure chart. Checked pressure

Date 10-15, 1977. Inspector James Clayton

RECEIVED

MAR 04 1982

UTILITY DIVISION
P. S. C. MO.

Form No. 744-5
(21-72)

GAS REGULATOR STATION - PRESSURE RELIEF
ANNUAL INSPECTION AND CHECK

STATION #1 Limited TOWN Centralia

1. Regulator: Sicker 298K

A. Hand hole or inspection plate removed and interior of regulator examined for defective valve discs, valve seats and worn linkage (note results and action taken.)

B. Regulator vents free of obstruction? yes

C. Gauges working properly? yes

D. Inlet pressure 47 lb/sq in Outlet pressure 11 in/hg

2. Pressure relief valve or monitor regulator:

A. Relief valve or monitor tested? turned off

Relief valve opened at? _____

Relief valve setting left at? _____

Monitor started to function at? _____

Monitor setting left at? _____

B. Relief vent free of obstruction? _____

C. Relief valve leaking through after test? _____

D. VALVE ON RELIEF LINE LEFT LOCKED IN OPEN POSITION? _____

3. Valves:

A. Plug valves lubricated? yes

B. By-pass line valves left in closed position? yes

C. All unhooded valves equipped with locking devices and locks? yes

4. General:

- A. Piping and equipment tested for leaks? yes Results? OK
- B. Building or vault vents free of obstruction? yes
- C. Piping, equipment and building paint in good condition? needs paint
- D. Station and grounds free of combustible material? yes
- E. "DANGER - GAS" or "CAUTION - GAS" signs posted? yes
- F. Door on building or vault left locked? yes

REMARKS: gas gauges checked OK

Date 10-16, 19 78. Inspector Jones

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MAR 04 1982

UTILITY DIVISION
P. S. C. MO.

Form No. 744-5
(11-71)

GAS REGULATOR STATION - PRESSURE RELIEF
ANNUAL INSPECTION AND CHECK

STATION # 1 - Tipton

TOWN Cartersville

1. Regulator:

- A. Hand hole or inspection plate removed and interior of regulator examined for defective valve discs, valve seats and worn linkage. (note results and action taken.)

Original Regulator.
Check Baller & Clock
check Pressure

- B. Regulator vents free of obstruction? yes
- C. Gauges working properly? yes
- D. Inlet pressure 40.4 Outlet pressure 10.4

2. Pressure relief valve or monitor regulator:

- A. Relief valve or monitor tested? Not tested
Relief valve opened at? No Test
Relief valve setting left at? No Test
Monitor started to function at? _____
Monitor setting left at? _____
- B. Relief vent free of obstruction? No Test
- C. Relief valve leaking through after test? No Test
- D. VALVE ON RELIEF LINE LEFT LOCKED IN OPEN POSITION? No Test

3. Valves:

- A. Plug valves lubricated? o.k.
- B. By-pass line valves left in closed position? yes
- C. All unhooused valves equipped with locking devices and locks? yes

1979 Annual Inspection Check.

4. General:

- A. Piping and equipment tested for leaks? OK. Results? _____
- B. Building or vault vents free of obstruction? yes
- C. Piping, equipment and building paint in good condition? no.
- D. Station and grounds free of combustible material? yes
- E. "DANGER - GAS" or "CAUTION - GAS" signs posted? yes
- F. Door on building or vault left locked? yes

REMARKS: _____

Date 8-22, 1979. Inspector Rand D. Jones

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UTILITY DIVISION
P. S. C. MO.

Form No. 744-5
(12-71)

GAS REGULATOR STATION - PRESSURE RELIEF
ANNUAL INSPECTION AND CHECK

STATION # 1.111111 TOWN Centralia

1. Regulators Fisher 298K

A. Hand hole or inspection plate removed and interior of regulator examined for defective valve discs, valve seats and worn linkage (note results and action taken.)

inspected reg

B. Regulator vents free of obstruction? yes

C. Gauges working properly? after work OK

D. Inlet pressure 47 lbs Outlet pressure 10 inches

2. Pressure relief valve or monitor regulator:

A. Relief valve or monitor tested? no

Relief valve opened at? _____

Relief valve setting left at? _____

Monitor started to function at? _____

Monitor setting left at? _____

B. Relief vent free of obstruction? yes

C. Relief valve leaking through after test? _____

D. VALVE ON RELIEF LINE LEFT LOCKED IN OPEN POSITION? no

3. Valves:

A. Plug valves lubricated? yes

B. By-pass line valves left in closed position? yes

C. All unhooded valves equipped with locking devices and locks? checked

4. General:

- A. Piping and equipment tested for leaks? yes Results? OK
- B. Building or vault vents free of obstruction? yes
- C. Piping, equipment and building paint in good condition? needs paint
- D. Station and grounds free of combustible material? yes
- E. "DANGER - GAS" or "CAUTION - GAS" signs posted? yes
- F. Door on building or vault left locked? yes

REMARKS: gauge lens stopped up & cleaned out.
Zero gauges, need to get inspiring for relief.
reg. marking freely. needs paint &
grit cut

Date 5-21-, 1980 Inspector J. Wittman

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Form No. 744-5
(11-71)

GAS REGULATOR STATION - PRESSURE RELIEF
ANNUAL INSPECTION AND CHECK

STATION #1 Lipton TANK Centralia

1. Regulator: Fisher 298K

A. Hand hole or inspection plate removed and interior of regulator examined for defective valve discs, valve seats and worn linkage (note results and action taken.)

Checked reg, found working freely

B. Regulator vents free of obstruction? yes

C. Gauges working properly? zeroed

D. Inlet pressure 46 lbs Outlet pressure 11 inches

2. Pressure relief valve or monitor regulator:

A. Relief valve or monitor tested? turned off

Relief valve opened at? _____

Relief valve setting left at? _____

Monitor started to function at? _____

Monitor setting left at? _____

B. Relief vent free of obstruction? _____

C. Relief valve leaking through after test? _____

D. VALVE ON RELIEF LINE LEFT LOCKED IN OPEN POSITION? no

3. Valves:

A. Plug valves lubricated? yes

B. By-pass line valves left in closed position? yes

C. All unhooused valves equipped with locking devices and locks? checked

4. General:

- A. Piping and equipment tested for leaks? yes Results OK
- B. Building or vault vents free of obstruction? yes
- C. Piping, equipment and building paint in good condition? needs paint
- D. Station and grounds free of combustible material? yes
- E. "DANGER - GAS" or "CAUTION - GAS" signs posted? yes
- F. Door on building or vault left locked? yes

REMARKS: Checked station, gas gauges,
gassed plug valves,
relief turned off. needs paint

Date 7-8-81 Inspector Charles Jones