



National Transportation Safety Board

Washington, D.C. 20594

Pipeline Accident Brief

Accident No.: DCA09FP003
Accident Type: Release, ignition, and explosion of natural gas
Location: Rancho Cordova, California
Date: December 24, 2008
Time: 1:35 p.m. Pacific standard time¹
Pipeline Operator: Pacific Gas and Electric Company
Fatalities: 1
Injuries: 5
Property Damage: \$267,000

The Accident

About 1:35 p.m. on December 24, 2008, an explosion and fire caused by a natural gas leak destroyed a house at 10708 Paiute Way in Rancho Cordova, California. One person suffered fatal injuries, and five other people, including one utility employee and one firefighter, were hospitalized as a result of the explosion. Two adjacent homes, one on either side, had severe damage, and several homes suffered minor damage. According to the Pacific Gas and Electric Company (PG&E), the property damage was \$267,000.

On December 24, 2008, at 9:16 a.m., the PG&E Customer Contact Center received a call from a resident at 10716 Paiute Way reporting a gas odor outside her house. The Customer Contact Center prepared a case ticket² and contacted the PG&E Dispatch Office (Dispatch). As part of normal procedure, PG&E Dispatch prepared a field order dispatching a gas service representative (technician) to 10716 Paiute Way.

About 9:21 a.m. on December 24, 2008, PG&E dispatched a technician to respond to 10716 Paiute Way with a field order to investigate an outside gas leak at a meter. The field order had a "zero" priority rating, which called for an immediate response. About 9:30 a.m., the technician entered a code into PG&E's field automation system using her laptop computer confirming that she had received the field order. About 9:55 a.m., she entered another code into the system indicating that she was en route to 10716 Paiute Way.

¹ All times in this brief are Pacific standard time.

² The Customer Contact Center creates a case number for each customer's call. Then a case ticket, or case ticket package, is prepared for the case number and entered into the company's information system. The case ticket consists of the printed request from the PG&E Dispatch Office, information from the customer's call, and sometimes a map of the pipeline(s) at the location to be investigated. The case ticket is used as a reference for all personnel responding, including the technician and maintenance personnel.

The technician arrived outside 10716 Paiute Way about 10:15 a.m. carrying a combustible gas indicator³ across the yard to the door of the house. Before reaching the door, she picked up natural gas readings in a water box⁴ outside the house. Because she had picked up gas readings in the yard, rather than at the house meter as directed in the field order, she decided that she needed assistance and better detection equipment. The technician met the resident outside the single-story⁵ house. The technician interviewed the resident and learned that she no longer smelled gas outside her house as she had when she called in the leak earlier that morning. The resident told the technician that she did, however, smell gas outside her next-door neighbor's house at 10712 Paiute Way, and she pointed out the neighbor who was standing at her door.

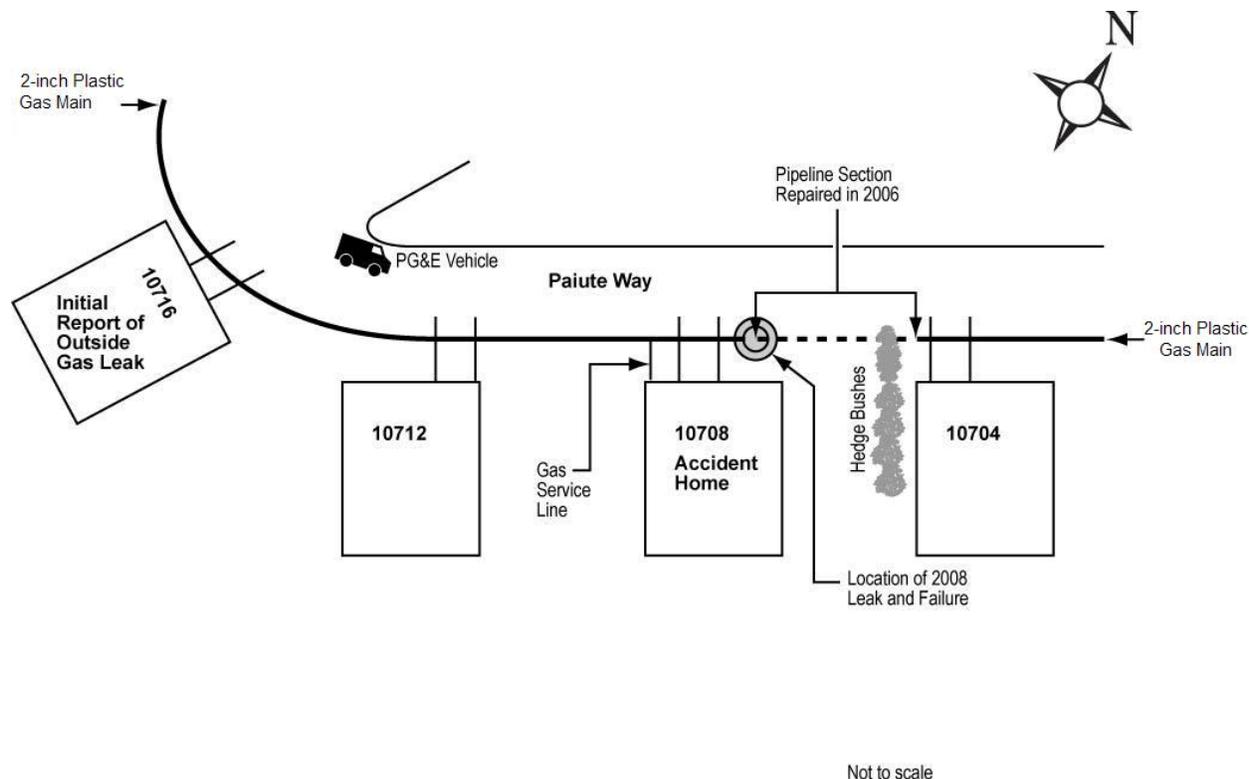


Figure 1. Diagram showing locations of houses, gas lines, leaks and leak reports, and PG&E vehicle.

³ The *combustible gas indicator* that the technician carried was a type that can detect gas concentrations between 0 and 5 percent and that is primarily used to detect gas inside a building.

⁴ A *water box* is put on a water line by the water company, and it allows a junction of water lines, a location for a meter, or a way of dispensing water without a hose or a faucet.

⁵ All houses on the street were single-story houses on concrete slabs.

About 10:24 a.m., the technician spoke to the next-door neighbor, who lived at 10712 Paiute Way, who told the technician that she had smelled a gas odor outside her house. The technician then asked the resident of 10712 Paiute Way to call PG&E's Customer Contact Center to report a leak in her yard. The Customer Contact Center subsequently received a call from the resident of 10712 Paiute Way about 10:29 a.m. reporting a strong gas odor outside her house in the garage area.

At 10:25 a.m., the technician called PG&E's Customer Contact Center on the dedicated telephone line that connects directly to the Dispatch Office. The technician requested that the 10716 Paiute Way case be forwarded to the maintenance and construction department (maintenance) so a maintenance crew could be dispatched to the scene to assist with the leak investigation. The maintenance crew would be equipped with a flame ionization detector (ionization detector) that can determine the location of a leak and its migration path,⁶ whereas the technician had a device that could handle only an inside leak. The PG&E Customer Contact Center created a case ticket for 10716 Paiute Way at 10:28 a.m.; the maintenance supervisor acknowledged the case ticket about 10:42 a.m. and dispatched a fieldman, a leak investigator, and a foreman to the scene.⁷

Recognizing the immediate need for assistance from an ionization detector crew, and because it was Christmas Eve and she was unsure how quickly maintenance could dispatch a crew, the technician then called Concord Dispatch⁸ directly about 10:32 a.m. to request that a maintenance crew respond to 10712 and 10716 Paiute Way. About 10:35 a.m., the technician made a second phone call directly to the PG&E Customer Contact Center to request that a maintenance crew be dispatched to 10712 Paiute Way to assist with the leak investigation. The Customer Contact Center created a case ticket for 10712 Paiute Way at 10:42 a.m.

PG&E requires a field order to be completed before a technician may proceed to the next work location. The technician knew that the call from the resident at 10712 Paiute Way would lead to the creation of a new field order for that address, so about 10:38 a.m. the technician completed the field order for 10716 Paiute Way in the field automation system. She then entered a code into the system indicating that she was en route to 10712 Paiute Way.

The technician immediately proceeded to 10712 Paiute Way, knocked on the door, and entered the house at the invitation of the female resident. The technician did not detect any gas inside the house, with the exception of a small, "fuzz," leak at the water heater, which was eliminated by tightening a fitting on the unit. Next, the technician went to the garage where she smelled "a little whiff" of natural gas. She then went back into the kitchen to investigate further and met the male resident, who indicated that the source of the leak was in his next-door neighbor's yard.

⁶ The ionization detector that the maintenance crew used was a full-range detector that can detect gas concentrations between 0 and 100 percent and that is used to detect gas outdoors.

⁷ The fieldman, the leak investigator, and the foreman were contacted and dispatched to the scene by the maintenance supervisor at 10:41 a.m., 10:42 a.m., and 12:30 p.m., respectively.

⁸ Concord Dispatch is for PG&E gas service technicians and is used only by PG&E personnel. The customer contact center is for customers and others to report gas leaks or other emergencies.

The resident led the technician outside and into the yard of 10708 Paiute Way. Once in the yard, the technician detected a natural gas leak at a patch of dead grass in the middle of the yard. The location of the leak was about 5 feet west of the driveway, about 45 feet from the house. The technician checked the gas meter at 10708 Paiute Way for leaks but did not find any.

After finding the leak in the yard and while returning to some of the houses to finish uncompleted clock tests,⁹ the technician was evaluating the terrain and her gas readings to try to judge the migration path of the natural gas. None of the clock tests on the three houses showed excessive flow across the meters.

The technician knocked on the door of 10708 Paiute Way in an attempt to gain entry and determine whether any leaks existed inside the house, but she received no answer. She then returned to her truck, parked it on the opposite side of the street between 10712 and 10716 Paiute Way, facing in the direction of 10708 Paiute Way, and waited beside it. She did not contact the fire department to request entry into the house, nor did she place signs on the doors or string up tape to warn residents that entry could be hazardous. The technician told investigators that she had become increasingly concerned about the leak at the time. As a result, over the next half-hour she made several phone calls to the PG&E Customer Contact Center, the maintenance department, Concord Dispatch, and the responding leak investigator in an attempt to determine whether the maintenance crew was en route and its estimated arrival time.

About 11:11 a.m., the technician called Concord Dispatch to request a field order for 10708 Paiute Way. The field order documented the leak in the front yard and that there was no excessive flow on the gas meter. About 11:17 a.m., the technician made a third call to the PG&E Customer Contact Center to request that the 10708 Paiute Way case be forwarded to the maintenance department so a crew could be dispatched to the scene to assist with the leak investigation. The Customer Contact Center created a case ticket for 10708 Paiute Way about 11:22 a.m.; the maintenance department acknowledged it at 11:26 a.m.

The maintenance department leak investigator arrived at the PG&E service center to pick up the ionization detector about 11:30 a.m. but had problems with his truck brakes, which forced him to acquire another truck and delayed his departure to Paiute Way. He called the technician three times, but he did not notify his supervisor of his delay, nor did he notify Dispatch of his delay. The leak investigator left the PG&E service center about 12:42 p.m., more than an hour after his arrival there.

About 11:49 a.m., the technician noted in the field order for 10712 Paiute Way that it appeared that the leak was in the vicinity of the patch of dead grass in the front yard of 10708 Paiute Way. After completing the field order in the field automation system, the technician made several calls to co-workers in an effort to determine the status of the responders. One of the gas

⁹ A *clock test* is used to determine whether there is unusual or excessive gas leakage inside a house. A gas service technician watches the gas meter to see how much gas is flowing per unit of time (typically, the number of cubic feet over 10 minutes).

service supervisors she spoke with advised her to stay on scene until she was relieved by the maintenance department.

According to the PG&E timeline, the foreman arrived on scene about 1:14 p.m. The foreman parked his truck behind the technician's truck, and they had a brief discussion. The technician told the foreman that none of the clock tests showed excessive flow across the meter and told him the locations where she obtained gas readings and smelled gas. She also told him that there was a leak in the yard of 10708 Paiute Way, but that she had been unable to gain entry into the house. The foreman relieved the technician, and she left the scene. The leak investigator (equipped with the ionization detector) arrived about 5 minutes later, 2 hours 47 minutes since the technician had called Concord Dispatch to request the specialized equipment to locate the leak. The fieldman arrived immediately after the leak investigator; both parked near the foreman's truck.

The foreman asked the leak investigator to display the plat¹⁰ on his laptop computer. The foreman and the fieldman reviewed the plat and then located and marked the service pipelines and a portion of the main pipeline with paint and flags. While the foreman and fieldman were marking pipelines, the leak investigator prepared the ionization detector at his truck.

About 1:27 p.m., the leak investigator was attempting to locate the leak on the main pipeline using the ionization detector when a neighbor walked up to the foreman and the fieldman and told them that a leak in the vicinity had been fixed once before. He was not sure of the exact location of the repair, but he said that he remembered that PG&E had dug two holes. The foreman then noticed sunken ground at two ends of the yard at 10708 Paiute Way.

About 1:34 p.m., the leak investigator located the dead grass in the front yard of 10708 Paiute Way and walked westward over the main pipeline between the two patches of sunken ground. The ionization detector's initial reading was 60,000 parts per million. The reading increased to 80,000 parts per million as the leak investigator continued to walk westward. When he reached the location of the leak, the device flamed out, meaning the flame of the ionization detector went out, and an alarm sounded. The flame-out signaled that the gas-to-air mixture was too rich to burn (that is, there was too much natural gas with the volume of air in the intake), which is indicative of a leak. The three PG&E employees then agreed that they had identified the leak location, and they discussed the likelihood of its being a subsurface leak.

About 1:35 p.m., the foreman went to his truck to get a probe and to prepare for use another type of gas detector, a combustible gas indicator that helps pinpoint leaks. Meanwhile, the leak investigator knocked on the door of 10708 Paiute Way and talked with a resident. When they had finished talking, he turned away from the house to begin further investigation, and the house exploded. (See figure 2.) The homeowner sustained fatal injuries as a result of the explosion.

¹⁰ The *plat* is a map that shows the locations of the main and service pipelines.



Figure 2. Damage caused by explosion.

Postaccident Investigation

A Sacramento Metropolitan Fire Department investigator interviewed the 17-year-old granddaughter of the owner of 10708 Paiute Way at Shriners Hospital for Children on December 29, 2008. According to the fire department, the granddaughter stated that her grandfather had told her of a gas odor in the house before she and her grandfather arrived home about 12:00 p.m. on December 24, 2008, and that she had smelled a strong odor of gas both outside and inside the house. She said that the PG&E leak investigator had knocked on the front door and that her grandfather and the leak investigator had gone outside. She went into the bathroom; shortly thereafter she heard a “whoosh” and two explosions, and she immediately escaped to the street.

On January 15, 2009, the lawyer for the family at 10708 Paiute Way provided information on behalf of the granddaughter in response to additional questions from National Transportation Safety Board (NTSB) investigators. According to the information from the lawyer, the granddaughter had not smelled gas inside the house at any time. She stated through the lawyer that she had arrived at the house shortly before noon and did not see any PG&E vehicles or personnel, nor did she see any kind of notice on the door prohibiting entrance before PG&E could check the premises for gas. She also stated that the PG&E leak investigator had not requested entry into the house to check for gas.

Emergency Response

On December 24, 2008, about 1:35 p.m., two Rancho Cordova police officers heard a very loud noise that sounded like an explosion, and they immediately notified their dispatch center, which was the Sacramento County Sheriff's Department Dispatch. After hearing from Sheriff's Dispatch that there had been calls about a possible explosion and learning of the possible location of the incident, the police officers drove toward the area. While en route, the officers heard multiple units of the Sacramento Metropolitan Fire Department dispatched to an explosion. First responders arrived on scene about 1:43 p.m. As the fire department worked to extinguish the fire, paramedics prepared the injured for transport. There were six injured, all of whom were transported to the hospital by 2:00 p.m. PG&E supervisors and the fire department verified that there was an active gas leak near the explosion site, and as a result, about 2:04 p.m. an evacuation was enforced 10 houses away from the explosion site in both directions. The fire department concluded the tactical response about 5:03 a.m. on December 25, 2008, when the evacuation was lifted.

Postaccident Excavation and Field Testing

Postaccident excavation revealed that the source of the natural gas leak was the main pipeline, where a spool piece¹¹ of pipe had partially pulled out of a 1 1/4-inch coupling. About 1/4 inch of polyethylene pipe was inside the Metfit¹² coupling, although at least 1 inch of pipe is held in a correctly assembled coupling. (See figures 3 and 4.) PG&E had installed the spool piece of pipe and the coupling during a September 21, 2006, repair of a leak to the 2-inch main pipeline. The sections of pipe and couplings from the accident were submitted to the NTSB's Materials Laboratory for testing. (See figure 4.)

¹¹ A *spool piece* of pipe is a short section of pipe used as a replacement pipe in a repair.

¹² Metfit is a type of pipe coupling owned by US Poly. When the pipeline was installed in 1977, the repair process and the Metfit name were owned by DuPont. Since then, the process and Metfit have changed hands several times. At the time of the repair (2006), US Poly owned both.

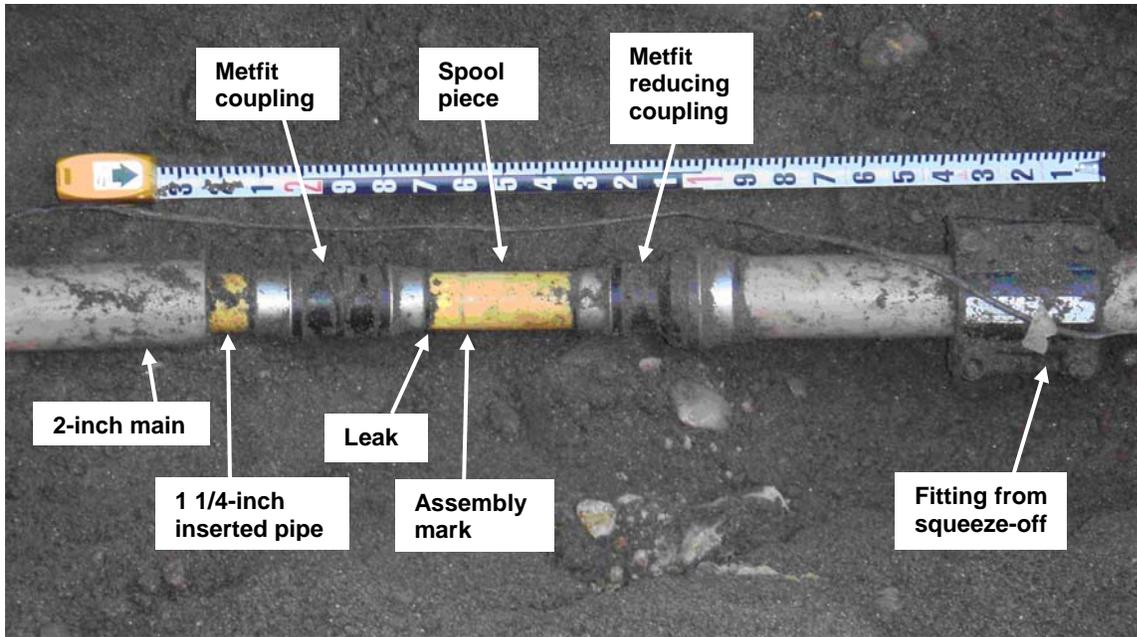


Figure 3. View from above of source of 2008 leak as discovered in the field. Distance between leak and assembly mark is 1 inch.

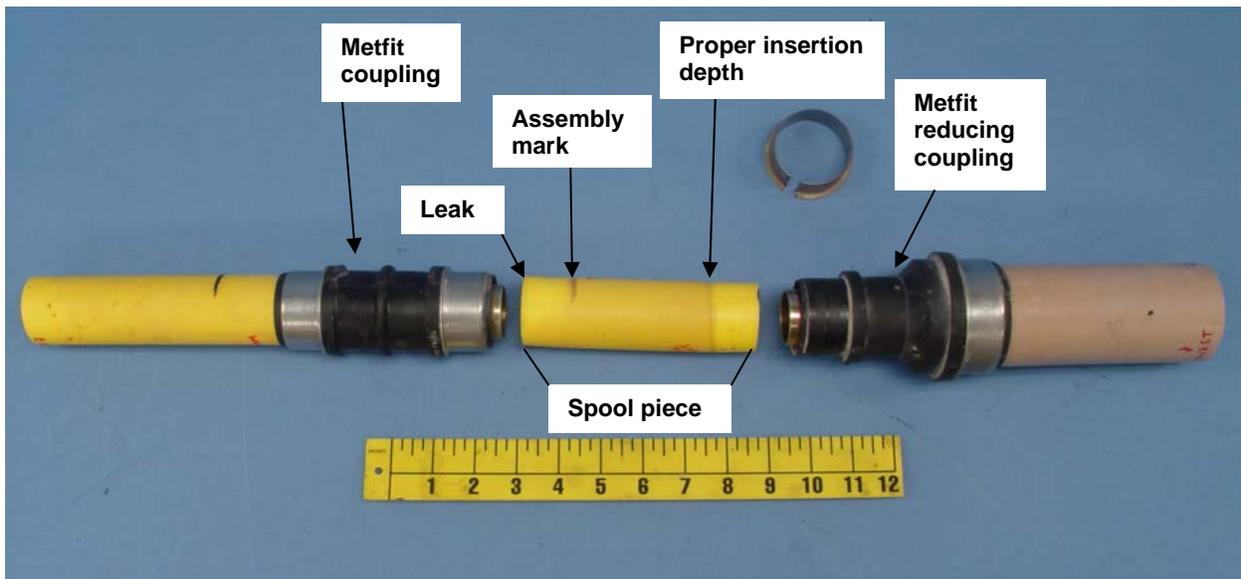


Figure 4. Pipeline components excavated from accident site.

Pipeline Information

The service pipeline to 10708 Paiute Way was a 1/2-inch DuPont Aldyl A polyethylene service pipeline fed by a 2-inch DuPont Aldyl A polyethylene gas main that had been installed in 1977. The maximum allowable operating pressure for the main and service pipelines was about 60 pounds per square inch, gauge (psig), and the working, or operational, pressure was about 55 psig.

Preaccident Leak/Repair

On September 15, 2006, about 7:00 a.m., PG&E received a gas odor complaint from the owners of 10708 Paiute Way. As a result, PG&E dispatched a crew to the house to evaluate the complaint about 4:00 p.m. that day. The crew determined that the source of the odor was a leak in the 2-inch Aldyl-A plastic pipe gas main located in front of the house, off the south side of the street.

One PG&E-approved method for making repairs on sections of polyethylene piping relies on the Metfit coupling. This coupling is a nylon and steel fitting that produces a gas-tight seal when the pipe ends are inserted into the coupling to the proper depth and the stainless steel rings are pushed over the fittings using a special installation tool and procedures. If the wall thickness or standard dimension ratio¹³ of the polyethylene pipe is within ASTM D-2513 tolerances, the fitting is gas tight, pullout proof, and reliable. PG&E and US Poly procedures require the installer to check the print line on the pipe and the markings on the fitting to be certain they are compatible. PG&E requires a pressure test of the repaired section at 100 psig of air pressure for 5 minutes and with natural gas at about 50 psig. PG&E also conducts soap tests for leaks on all repairs before putting them in service.

To make the repair at 10708 Paiute Way, PG&E severed the original 2-inch main at two locations about 22 feet apart and inserted a section of 1 1/4-inch polyethylene plastic pipe inside the older 2-inch Aldyl-A plastic pipe across the leak. The repair pipe inserted into the 2-inch main was a 1 1/4-inch iron pipe size¹⁴ polyethylene pipe manufactured by US Poly that also had a maximum allowable operating pressure of 60 psig and a working pressure of about 55 psig. The inserted pipe sections were joined to the original 2-inch main with two US Poly Metfit 1 1/4-inch by 2-inch reducing couplings¹⁵ and one 1 1/4-inch coupling. Specifically, the main was reconnected by installing a 2-inch to 1 1/4-inch Metfit reducing coupling to join one end of the severed 2-inch main to one end of the 256-inch-long 1 1/4-inch polyethylene pipe. On the other end, to obtain sufficient movement to complete the repair, the long 1 1/4-inch insert pipe was then joined by a 1 1/4-inch Metfit straight coupling to an about 6-inch-long piece of 1 1/4-inch polyethylene pipe. This short pipe section, or spool piece, was joined to the other severed end of the 2-inch main by a Metfit 1 1/4-inch to 2-inch reducing coupling. Upon completion of the repair, PG&E pressurized the repaired section at 100 psig of air pressure for 5 minutes, and,

¹³ The standard dimension ratio of pipe is the outside diameter divided by the wall thickness.

¹⁴ All pipe dimensions in this brief are given as iron pipe size measurements unless otherwise noted.

¹⁵ A *reducing coupling* connects a smaller pipe to a larger one.

with natural gas at about 50 psig, PG&E soap tested¹⁶ for leaks. The repair was completed on September 21, 2006. PG&E checked its records of odor/leak complaints and found that no reports of odor/leaks in the Paiute Way neighborhood were received between September 21, 2006, and the morning of the accident.

Postaccident PG&E Investigation

After the December 24, 2008, accident, PG&E and the California Public Utilities Commission investigated the records of other 1 1/4-inch plastic piping repairs to determine whether Metfit coupling leakage or pullout had been encountered elsewhere in the PG&E system. It was discovered that one other incident had occurred.

That incident occurred on October 7, 2006, in Sacramento, California, when an attempt to repair a 1 1/4-inch polyethylene pipe used four Metfit couplings, each of which leaked and failed when it was tested during installation. PG&E sent sections of pipe and the four couplings to US Poly for evaluation because PG&E initially believed that the couplings were the cause of the installation failure. US Poly measured three of the fittings and the pipe and concluded that (1) the pipe did not meet the American Society for Testing and Materials (ASTM) tolerance for wall thickness and (2) the failure apparently occurred when the thin-walled pipe slipped out of the Metfit couplings. However, because the pipe was not long enough to contain the entire print line, including the manufacturer's identification, US Poly was not convinced that the pipe tested was US Poly pipe. PG&E, which stated that it used only US Poly pipe, checked its truck and yard stock for all unused 1 1/4-inch polyethylene pipes with matching print lines. These pipes were measured for wall thickness and outside diameter, and all were found to meet ASTM D-2513, *Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings*, specifications. PG&E felt that the October 7, 2006, incident was an isolated incident and as a result did not follow up with the manufacturer beyond the original contact with US Poly or perform further reviews within PG&E. JM Eagle, which purchased the assets of US Poly in 2007, conducted a search of its wall thickness monitor records for 2005 through 2007 and found no readings below the minimum specified in ASTM D-2513. Furthermore, JM Eagle surveyed its 10 largest customers, and none reported any wall thickness problems of any type with their specification pipe. The sections of pipe and couplings that PG&E reported were from the October 7, 2006, incident were submitted to the NTSB's Materials Laboratory for testing.

Tests and Research

The polyethylene pipe sections and couplings taken from the accident site were examined and measured at the NTSB's Materials Laboratory. (See table 1.)

¹⁶ In a *soap test*, a soap solution is applied to a gas pipe that may have a leak. If gas is leaking, soap bubbles will form.

Table 1. Measurements of pipe samples.

Source	Sample	Outer diameter (inches)	Wall thickness (inches)	Meets Wall Thickness Requirements ^a	Print line
Rancho Cordova	Long piece	1.660	0.172–0.176	Yes	Yes
	Spool piece	1.662	0.148–0.152	No	No
October 7, 2006, Installation	Socket fusion piece 1	1.660	0.145–0.153	No	Yes
	Socket fusion piece 2	1.660	0.169–0.181	Yes	Yes
	A-1	1.660	0.150–0.155	No	Yes
	A-2	1.650	0.146–0.152	No	Yes
	A-3	1.661	0.171–0.175	Yes	Yes
	A-4	1.662	0.171–0.175	Yes	Yes
	A-5	1.655	0.146–0.153	No	Yes
	B	1.667	0.168–0.183	Yes	Yes
	B-3	1.666	0.141–0.146	No	Yes
PG&E Storage Yards	C	1.661	0.113–0.121	No	No
	D	1.654	0.174–0.176	Yes	No
	E	1.659	0.174–0.178	Yes	No
	F	1.662	0.171–0.178	Yes	Yes

^a ASTM D-2513 wall thickness specifications for 1 1/4-inch polyethylene pipe with a standard dimension ratio of 10.

The Metfit coupling was designed for 1 1/4-inch polyethylene plastic pipe with a standard dimension ratio of 10 (SDR 10) and a nominal outside diameter of 1.662 inches and a minimum wall thickness of 0.166 inch. Furthermore, the Metfit coupling installation instructions state, “Warning: before beginning installation, confirm that the pipe sizes and wall thickness (Standard Dimension Ratio) exactly match what is marked on the reducer or bag packaging.”

The examination of the pipe sections from the accident site revealed that the 20-foot-long inserted section of 1 1/4-inch polyethylene pipe met the requirements of ASTM D-2513. This section of pipe had an outside diameter of 1.662 inches and a wall thickness range of 0.172 to

0.176 inches, and it was marked in accordance with ASTM D-2513. The proper wall thickness of ASTM D-2513 1 1/4-inch SDR 10 polyethylene pipe is 0.166 to 0.186 inches.

The short, 6-inch piece of 1 1/4-inch spool pipe had no markings at all, an outside diameter of 1.662 inches, and a wall thickness of 0.148 to 0.152 inches, significantly thinner than the minimum wall thickness for ASTM D-2513 SDR 10 pipe. The coupling cannot be tightened with sufficient sealing pressure if the wall thickness of the pipe does not meet the minimum specifications. Marks made by the field installer were found on all of the piping installed by PG&E, and they indicated the proper depth for insertion of the pipe into the coupling.

Additional testing was conducted on pipes that PG&E said were part of the October 7, 2006, installation that had been joined with Metfit mechanical couplings and that reportedly had experienced a series of leaks and repairs. Pipe sections 1 and 2 were joined by a socket fusion coupling. PG&E also said that all of the sections of pipe involved in this installation were to be 1 1/4-inch SDR 10 pipe. The pipe sections were labeled by PG&E with a letter and/or number combination. The pipe sections retained a number of thick, dark ink marks that appeared to be related to installation, as well as a number of marks and labels indicating that they had been previously examined, with the marks showing positions where measurements had been taken and the labels showing the results of those measurements. The NTSB's Materials Laboratory measurements showed that four of the pipe sections met the ASTM D-2513 specification for 1 1/4-inch SDR 10 polyethylene pipe and four had wall thicknesses too thin for specification pipe.

Four additional pipe sections provided to the NTSB had not been placed in service and had been found in PG&E storage yards. Each of these sections was labeled with a letter (C through F). The types and sources of those sections were identified as follows:

- C & D Packing pipe¹⁷ from the Pipeline marker bin at the Sacramento service center
- E Packing pipe that supported coils of specification pipe at the Fremont materials yard
- F Specification pipe with poor-quality print lines from the Fremont materials yard

There were no print line markings on sections C, D, or E, and these pipe sections either came from the pipeline marker bin at PG&E's Sacramento yard or were recovered sections of packing pipe. The wall thickness of section C was too thin to meet the ASTM D-2513 specification, but the other segments met the specification according to dimensional measurements made by the NTSB's Materials Laboratory (shown in table 1).

Four pieces of pipe (both pieces from the Rancho Cordova accident; sample A-2 from the October 7, 2006, installation; and piece C from the PG&E yards) were sent to GTI Laboratories for further testing of melt flow rate and density. All four specimens were within tolerances for specification pipe. The test results indicated that all were correct gas-grade polyethylene. The melt flow rate and the density of the spool piece and the packing pipe (C) were identical.

¹⁷ The term *packing pipe* refers to unmarked pipe lengths included in the material used to pack pipe for transport.

PG&E Use of Packing Pipe

Depending on the quantity of polyethylene pipe being packed for shipment, US Poly sometimes uses unmarked, that is, nonspecification, polyethylene pipe lengths as part of the packing material. The pipe used for packaging is made from the same resin and on the same equipment as specification pipe products. However, the packing pipe has no print line markings and may vary greatly in dimension from specification pipe. This packing pipe is not intended for use as a specification pipe product.

On February 19, 2009, PG&E and California Public Utilities Commission party representatives jointly inspected the PG&E storage yard in Sacramento as part of the Rancho Cordova accident investigation. They found two pieces about 6 feet long of 1 1/4-inch polyethylene pipe that had no print line markings in a bin labeled “Stub Markers¹⁸ Only.” PG&E sent the pipes to the NTSB’s Materials Laboratory for examination and testing; one of the two pipes (C) had a wall thickness thinner than the minimum wall thickness required for ASTM D-2513 SDR 10 polyethylene pipe, and no print lines or indentations were observed on either C or D.

PG&E stated that it had a sole-source contract in place with US Poly, and thus any polyethylene gas piping it received would have been US Poly pipe. Under the contract, the pipe was shipped to PG&E’s main warehouse facilities, where it was inspected and then distributed to PG&E facilities throughout the service territory. On February 24, 2009, PG&E conducted a search of its warehouse facility in Fremont to further investigate the source of the unmarked pipe found in Sacramento. The party representative found pallets of coiled 1 1/4-inch polyethylene pipe manufactured by US Poly. The pallets contained four pieces of straight, unmarked polyethylene pipe on the corners of the pallet, apparently used to support the coils. These were the only nonspecification pipes found during the inspection of the Fremont warehouse.

There was no PG&E policy or practice in place at the time of the accident that provided direction on the use of packing pipe. PG&E determined that the Sacramento yard had an informal practice of using packing pipe as stub markers. The packing pipe was stored in separate bins for stub markers. During PG&E’s investigation, two pieces of unmarked 1 1/4-inch polyethylene pipe were found in one of these bins. Neither piece had a print line marking. PG&E reported that no other PG&E yard used the packing pipe for any purpose.

Response to Odor and Leak Reports

The PG&E response to odor complaints and leak reports begins with a caller reporting a gas odor inside or outside a house. In response to a phone call reporting a gas odor inside or outside a house, the PG&E Customer Contact Center prepares a case ticket and contacts PG&E Dispatch. As part of normal procedure, PG&E Dispatch prepares a field order from the case ticket containing a map and information on the customer’s call and this becomes a reference for all responding personnel. Field orders are prioritized: priority “zero” requires an immediate response. A supervisor stated that, in some cases, personnel drop whatever they are doing to respond to a field order with this priority.

¹⁸ A *stub marker* is a piece of pipe stuck in the ground to indicate that plastic pipe is buried there.

The first responder is a technician who carries a combustible gas indicator with a limited range that is designed for indoor leaks. These technicians are not trained to grade outdoor leaks.

PG&E technicians operate in accordance with California Public Utilities Commission Utility Standard S6434 and PG&E Utility Work Procedure WP6434-01, "Gas Leak Test Using a Combustible Gas Indicator." A technician who is confronted with an outdoor leak is to call Dispatch and request that a maintenance crew be sent to the scene. The maintenance crew is equipped with an ionization detector that can determine the exact leak location outdoors. The operator is also trained to determine the gas migration path.

The Customer Contact Center creates a case ticket for the house, and once the maintenance crew arrives and determines the grade of the leak, the gas distribution supervisor is notified and a gas repair crew is sent to make the repairs.

This accident illuminates shortcomings in PG&E's response procedures. First, at the time of the accident, PG&E did not require any of the responders to periodically check in with their dispatch offices to communicate delays in responding. Second, PG&E sent technicians (gas service representatives) as the first responders to leak complaints. These technicians were neither trained in grading outdoor leaks nor equipped with the equipment required to do so under PG&E's operator qualification program. A technician who encountered an outdoor leak was required to call Dispatch and have a leak inspector (equipment operator) sent to grade the leak. Third, technicians responding to odor and/or leak complaints did not have barrier tape or notices that could be used to warn an absent homeowner that the house was dangerous because of leaking gas and not to enter the house.

California Public Utilities Commission Audit

The California Public Utilities Commission audited PG&E in early May 2008. The audit determined that PG&E was in violation of Title 49 *Code of Federal Regulations* 192.615 (a)(3) and (a)(4) regarding emergency plans. It found that the PG&E procedure for field service representatives responding to gas leaks did not define the term "hazardous leak," nor did PG&E qualify field service representatives on the use of gas detection equipment and grading leaks outdoors.

On August 1, 2008, the California Public Utilities Commission sent a letter to PG&E listing the areas of violation found during the May 2008 audit and requesting corrective action. In the letter, the California Public Utilities Commission ordered the company to review its procedures and make certain that all personnel who respond to reports of gas leaks have the proper training and equipment. The letter also noted the following:

The process in [Utility Operations] Standard UO-6434, wherein events requiring immediate attention are identified and classified by persons not qualified to make such decisions, has the real potential to prevent or delay qualified personnel from timely responding to, and correcting what can be, very hazardous conditions.¹⁹

¹⁹ S. K. Shori, California Public Utilities Commission, letter (Notice of Violations of General Order 112E – Compliance Inspection of PG&E's Fresno Division) to G. Carter, PG&E, August 1, 2008.

PG&E responded in a November 5, 2008, letter in which PG&E agreed with the findings and said it would take certain actions. PG&E agreed to

- Update the UO-6434, “Gas Leak and Odor Response,” procedure systemwide,
- Define the term “hazardous leak,” and
- Properly train, qualify, and provide the proper equipment to the gas service representatives to grade outdoor leaks. This information was to be communicated to PG&E personnel no later than December 31, 2008, in the form of a gas information bulletin.

PG&E Postaccident Actions

Since the December 24, 2008, accident, PG&E reported to the NTSB that it has undertaken a number of process improvement initiatives to improve response time and efficiency and to preclude the introduction of nonspecification pipe for repairs. The following is a summary list of those efforts:

- Field service representatives have been trained, qualified, and given the necessary combustible gas detector equipment, in addition to the indoor natural gas detectors they previously carried, to conduct outdoor leak investigations and grade outdoor leaks.
- If gas above 1 percent is found indoors, the structure is to be evacuated and Dispatch is to be contacted to request 911 assistance.
- A prescriptive written evacuation policy has been established that utilizes the expertise of the fire department and first responders.
- Field technicians carry warning tape that they can use to cover entrances to warn homeowners not to enter the premises during leak investigations in the event that PG&E is unable to gain access during an investigation.
- The term “hazardous leak” is now more specifically defined in the PG&E operating instructions, and the written instructions include two examples of leaks that qualify as hazardous.
- Packing pipe is explicitly prohibited from any use and must be discarded.
- Written requirements have been established to check the wall thickness, outside diameter, and print line on all plastic pipes before installation to be certain that the mechanical fittings are compatible with the pipe.
- Heat fusion saddle installation procedures previously used to join service lines to the 1 1/4-inch polyethylene distribution lines have been replaced with an electrofusion process that is a safer and more reliable means of joining the service and distribution lines.

- Written requirements have been established that all incoming plastic pipe be checked for dimensions with the national and/or PG&E specification standards by PG&E quality assurance personnel and that nonconforming materials be returned to the vendor or scrapped.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the December 24, 2008, release, ignition, and explosion of natural gas in Rancho Cordova, California, was the use of a section of unmarked and out-of-specification polyethylene pipe with inadequate wall thickness that allowed gas to leak from the mechanical coupling installed on September 21, 2006. Contributing to the accident was the 2-hour 47-minute delay in the arrival at the job site of a Pacific Gas and Electric Company crew that was properly trained and equipped to identify and classify outdoor leaks and to begin response activities to ensure the safety of the residents and public.

Adopted: May 18, 2010