



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log P-303

Date: May 21, 1992

In reply refer to P-92-16 though -18

Mr. Richard Clark
President
Pacific Gas and Electric Company
77 Beale Street
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About 4:26 a.m. on December 28, 1991, two explosions in rapid succession occurred in apartment No. 3 of a two-story, eight-apartment, wood-frame structure at 631 Spencer Street, Santa Rosa, California. Fire after the explosions destroyed that apartment and three other apartments in the front of the building. Two people were killed and three others were injured. The only gas appliance in the apartment building was a hot water heater in a rear apartment. It remained undamaged by the explosions or fire. None of the building residents reported smelling the odorant that is added to natural gas, but later tests showed that the odorant level met Federal requirements.

The explosions and fire were reported promptly to the Santa Rosa Fire Department. Fire department personnel arrived on scene and began fighting the fire in apartment No. 3. Later, they observed bluish-yellow flames along the concrete slab foundation of apartment no. 3 and similarly colored flames on the ground between the street sidewalk and the building. At 5:31 a.m., the fire department notified Pacific Gas and Electric Company (PG&E) of a possible gas leak. At 5:37 a.m., the PG&E dispatched an on-call gas serviceman who arrived at the explosion site at 6:00 a.m. The gas serviceman checked for gas leaks and verified a leak that required immediate repair action. At 6:20 a.m., a PG&E on-call supervisor was notified that a gas leak existed and required immediate action. At 6:40 a.m., he dispatched a PG&E crew and supervisor to identify the problem and make necessary repairs.

At 7:30 a.m., the repair crew arrived and conducted gas leak tests over the gas main in the street, over the gas service line to the building at 631 Spencer Street, and around that building's foundation slab. The repair crew obtained a reading of 100 percent over the gas main-to-service connection beneath Humboldt Street for 701 Spencer Street (a building across Humboldt Street from the damaged building). However, the crew detected no gas-in-air readings over the gas service line that served 631 Spencer Street. They obtained gas-in-air readings up to 10 percent around the building foundation slab.

The PG&E crew excavated the 701 Spencer Street gas main-to-service connection that was 31 inches below the surface of Humboldt Street. From the 1/2-inch-diameter plastic service line connected to the gas main, they found gas escaping at a pressure of 50 psig. About 2 feet from the gas main, the service line had separated about 3 1/2 inches from the compression coupling that joined the 1/2-inch-diameter plastic pipe to a 1-inch-diameter plastic pipe. At 10:49 a.m., the crew squeezed closed the 1/2-inch plastic pipe near its connection to a 2-inch-diameter plastic gas main to stop the release of natural gas. The soil near the service line separation still contained moisture, indicating that the gas leak had not existed for an extended period.

Next, the PG&E crew excavated the service line for 701 Spencer Street (a multi-unit apartment building that also had only one gas customer). The 1-inch-diameter service line had been inserted through a 1 1/4-inch-diameter steel pipe (sleeve) that was 2 feet below the street surface and had once been used as the service line. In August 1991, an 8-inch-diameter sewer line was installed perpendicular to the service line. At that location, approximately 5 feet of steel sleeve was found displaced northward about 6-inches. Also, the south side of the displaced sleeve segment had two dents about 2 feet apart near its center. Judged by the spacing of the dents, they appeared to have been made by excavation equipment such as a backhoe bucket.

The PG&E records show that in 1970 the PG&E renewed the service line to 701 Spencer Street by inserting a new 1-inch-diameter plastic service line from the then low pressure 4-inch steel gas main through the existing 1 1/4-inch steel service line. In 1972, the PG&E abandoned the 4-inch steel low pressure gas main in Humboldt Street, inserted a 2-inch-diameter plastic main through the abandoned steel main, and converted the gas system to deliver high pressure natural gas. The PG&E tested the existing 1-inch service lines using air to a pressure of 100 psig. To reconnect the service lines to the main, the old steel main was cut away to access the plastic main, and a 2- by 1/2-inch plastic tapping tee was fused to the plastic main. About 2 feet of 1/2-inch-diameter plastic pipe was used to connect the tapping tee to the existing 1-inch plastic service. A 1/2- by 1-inch plastic compression coupling was used to connect the ends of the two plastic pipes.

The Safety Board investigation disclosed that the city of Santa Rosa provided the PG&E with construction drawings of proposed street improvement work for a 1/2-mile square area that included the accident site. It invited the PG&E to attend an April 15, 1991, preconstruction meeting. The PG&E did not attend because its review of the drawings revealed no gas lines would have to be moved to accommodate the proposed water and sewer mains. Before beginning work on the street improvement project, the contractor, North Bay Construction Inc., notified the appropriate one-call excavation notification system, USA North, about the start of the project. Consistent with its policy for monitoring excavation work near its distribution pipelines, the PG&E had surveyed the area for gas leaks and painted marks on the road surface indicating the location of PG&E gas lines in the proposed excavation areas. At the time PG&E employees mark the gas line locations in an area, they are to discuss with on-scene contractor personnel the purpose of the markings, the necessity to hand-dig to expose the gas lines, and to call the

PG&E to report any damage to its gas lines. At 14-day intervals, as required by State law, a PG&E crew again marked the location of PG&E underground gas lines within the proposed excavation areas. The PG&E assigned no inspection personnel to observe the contractor's excavation work near the gas lines.

The PG&E's records show that between May and September 1991, the contractor's excavation operations had damaged and/or severed several gas mains and service lines. On August 14, 1991, while excavating to install a sewer main on Humboldt Street, the contractor's backhoe struck and ruptured a 2-inch-diameter high pressure plastic gas main in Spencer Street. The fire department evacuated residents from the houses adjacent to the street intersection, and the police department rerouted traffic. On August 28, 1991, while excavating for a new sewer service lateral, the contractor's backhoe struck and ruptured the 1/2-inch-diameter high pressure plastic gas service line to 1125 Humboldt Street. On August 30, 1991, while excavating to install a sewer main, the contractor severed the 1/2-inch-diameter high pressure plastic gas service line to 1030 Humboldt Street. Each of these gas lines were buried 2 feet or deeper, and their locations had been marked before excavation began.

After the accident, PG&E leak-surveyed 67 locations along where the contractor's excavation crossed its service lines. The survey detected a leak on the service line to 1154 Humboldt Street. In repairing that leak, PG&E discovered that the steel casing for the plastic service line to 1154 Humboldt Street had been bent and displaced in a manner similar the service line to 701 Spencer Street. Gas was also found leaking from the tee fitting that connected the plastic service line to the gas mains. The PG&E is continuing to survey other locations where the contractor's excavation crossed its service lines.

State law requires that owners of underground facilities mark the location of their facilities within 24 inches. For extended excavation operations, they must remark facilities every 14 days while excavation is continuing. Excavators are required to hand-dig to uncover and locate buried facilities that have been marked. The State law includes penalties for noncompliance up to \$50,000. However the law has not been effective in preventing excavation-caused damages because of the State's large backlog of court cases.

Although this accident investigation is continuing, it appears that excavation equipment struck and damaged the gas service line. The PG&E received no notice of the service line damage, possibly because at the time of excavation, the service line was not completely separated from the compression coupling and no gas was escaping. Traffic vibration, pipe shrinkage caused by significant temperature differences between the time of the service line displacement and the time of the accident, or other yet undetermined actions provided the force to separate the plastic pipe from the compression coupling. Natural gas, escaping under a pressure of 50 psig from the separated pipe, migrated underground into the apartment building where it ignited, exploded, and then fueled the resulting fire.

Had PG&E known that the service line for 701 Spencer Street was damaged, the gas company would have had an opportunity to inspect the damage, make repairs, and prevent this accident. PG&E could have increased the potential that it would have been notified of damages to its pipelines had it attended the preconstruction meeting and discussed the dangers of not reporting damages. PG&E could have implemented an effective program to provide to general contractors information on the importance of reporting to PG&E any contact or damage to gas lines by mechanized excavation equipment. Also, after the contractor had repeatedly struck and ruptured its gas lines, PG&E could have assigned an employee to monitor the contractor's excavation operations. Any of the above actions might have significantly reduced the potential for damage to its gas lines and increased its opportunity to learn of the damage to 701 Spencer Street's service line.

Between the late 1960's and early 1970's, the PG&E assessed the usefulness of excess flow valves (EFVs) to automatically stop the flow of gas when service lines were ruptured due to excavation damage, earthquakes, or other causes. PG&E determined that the EFVs then available were not sufficiently reliable and decided not to install them. Since their initial assessment, the PG&E has not considered using EFVs even though their design has improved significantly. Although PG&E has not installed EFVs on its service lines, the company does allow customers to install approved seismic shut-off valves on the house fuel piping downstream of the gas meter.

The Safety Board believes that had an EFV been installed on the service line at the connection to the Spencer Street gas main, the valve would have promptly closed after the service line separated from the compression coupling. This closure would have likely prevented the release of gas sufficient to form an explosive mixture in the apartment building and the likelihood of this accident. Additionally, an EFV would have prevented the continued release of gas during the emergency response activities and endangerment to firefighters and other emergency personnel.

Therefore, the National Transportation Safety Board recommends that the Pacific Gas and Electric Company:

Install excess flow valves on new and renewed high-pressure, single-customer residential gas service lines at or near their connections to the gas main. (Class II, Priority Action)(P-92-16)

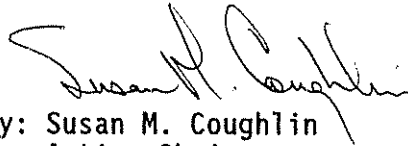
Implement an effective program to alert excavators of the urgent need to promptly notify PG&E of any contact, or suspicion of contact, by mechanized equipment or other damage to its gas pipelines whether a leak is or is not indicated. (Class II, Priority Action) (P-92-17)

Conduct on-site inspections of extended adjacent excavation operations to prevent potential pipeline damage, basing the frequency on the excavator's past performance. (Class II, Priority Action)(P-92-18)

The National Transportation Safety Board is an independent Federal

agency with statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations P-92-16 through -18 in your reply.

COUGHLIN, Acting Chairman, and LAUBER, HART, HAMMERSCHMIDT, and KOLSTAD, Members, concurred in these recommendations.



By: Susan M. Coughlin
Acting Chairman