



# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

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**Date:** January 3, 2011

**In reply refer to:** P-10-2 and -3 (Urgent) and  
P-10-4

Mr. Christopher Johns  
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The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. The urgent safety recommendations in this letter are derived from the NTSB's ongoing investigation of the natural gas pipeline rupture and explosion that killed eight people in San Bruno, California, on September 9, 2010. The NTSB would appreciate a response from you within 30 days addressing the actions you have taken or intend to take to implement our recommendations.

On September 9, 2010, about 6:11 p.m. Pacific daylight time,<sup>1</sup> a 30-inch-diameter natural gas transmission pipeline (Line 132) owned and operated by Pacific Gas and Electric Company (PG&E) ruptured in a residential area in the city of San Bruno, California. The accident killed eight people, injured many more, and caused substantial property damage. The rupture on Line 132 occurred near milepost 39.33, at the intersection of Earl Avenue and Glenview Drive in San Bruno. About 47.6 million standard cubic feet of natural gas were released as a result of the rupture. The rupture created a crater about 72 feet long by 26 feet wide. A ruptured pipe segment about 28 feet long was found about 100 feet away from the crater. The released natural gas was ignited sometime after the rupture; the resulting fire destroyed 37 homes and damaged 18.

When the NTSB arrived on scene on September 10, the investigation began with a visual examination of the pipe and the surrounding area. The investigators measured, photographed, and secured the ruptured pipe segment. On September 13, the ruptured pipe segment and two shorter segments of pipe, cut from the north and south sides of the ruptured segment, were crated for transport to an NTSB facility in Ashburn, Virginia, for examination.

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<sup>1</sup> All times mentioned in this letter refer to Pacific daylight time, unless otherwise specified.

According to PG&E as-built drawings and alignment sheets, Line 132 was constructed using 30-inch-diameter seamless steel pipe (API 5L Grade X42) with a 0.375-inch-thick wall. The pipeline was coated with hot applied asphalt and was cathodically protected. The ruptured pipeline segment was installed circa 1956. According to PG&E, the maximum allowable operating pressure (MAOP) for the line was 400 pounds per square inch, gauge.

The NTSB's examination of the ruptured pipe segment and review of PG&E records revealed that although the as-built drawings and alignment sheets mark the pipe as seamless API 5L Grade X42 pipe, the pipeline in the area of the rupture was constructed with longitudinal seam-welded pipe. Laboratory examinations have revealed that the ruptured pipe segment was constructed of five sections of pipe, some of which were short pieces measuring about 4 feet long. These short pieces of pipe contain different longitudinal seam welds of various types, including single- and double-sided welds. Consequently, the short pieces of pipe of unknown specifications in the ruptured pipe segment may not be as strong as the seamless API 5L Grade X42 steel pipe listed in PG&E's records.<sup>2</sup> It is possible that there are other discrepancies between installed pipe and as-built drawings in PG&E's gas transmission system. It is critical to know all the characteristics of a pipeline in order to establish a valid MAOP below which the pipeline can be safely operated. The NTSB is concerned that these inaccurate records may lead to incorrect MAOPs.

The MAOP for a pipeline can be established by conducting a hydrostatic pressure test that stresses the pipe to 125 percent of the desired MAOP without failure. In a hydrostatic pressure test, a pipe segment is typically filled with water at a specific pressure for a specific period of time to test the strength of the pipe. Hydrostatic testing requirements and restrictions for natural gas pipelines are specified in Title 49 *Code of Federal Regulations* (CFR) Part 192, Subpart J. The spike test is a variation of the hydrostatic pressure test in which a higher hydrostatic pressure, usually 139 percent of the MAOP, is applied for a short period of time (typically about 30 minutes). The spike test is intended to eliminate flaws that may otherwise grow and cause failure during pressure reduction after the hydrostatic test or resulting from normal operational pressure cycles. It is advantageous to include a spike test because it limits the time the line is at the higher pressure to reduce the potential amount of crack growth. Although hydrostatic testing is recognized to be a direct and effective methodology for validating an MAOP, its implementation requires that operating lines be shut down, which may adversely affect customers dependent on the natural gas supplied by the pipeline, particularly if the pipe fails during the test, which could necessitate a protracted shutdown. Consequently, it is

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<sup>2</sup> PG&E's records identify Consolidated Western Steel Corporation as the manufacturer of the accident segment of Line 132. However, after physical inspection of the ruptured section, investigators were unable to confirm the manufacturing source of some of the pieces of ruptured pipe. Determining the identity of the manufacturer of these pieces of pipe is an ongoing part of the investigation.

preferable to use available design, construction, inspection, testing, and other related records<sup>3</sup> to calculate the valid MAOP.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Pacific Gas and Electric Company:

Aggressively and diligently search for all as-built drawings, alignment sheets, and specifications, and all design, construction, inspection, testing, maintenance, and other related records, including those records in locations controlled by personnel or firms other than Pacific Gas and Electric Company, relating to pipeline system components, such as pipe segments, valves, fittings, and weld seams for Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4<sup>4</sup> locations and class 1 and class 2<sup>5</sup> high consequence areas<sup>6</sup> that have not had a maximum allowable operating pressure established through prior hydrostatic testing. These records should be traceable, verifiable, and complete. (P-10-2) (Urgent)

Use the traceable, verifiable, and complete records located by implementation of Safety Recommendation P-10-2 (Urgent) to determine the valid maximum allowable operating pressure, based on the weakest section of the pipeline or component to ensure safe operation, of Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing. (P-10-3) (Urgent)

If you are unable to comply with Safety Recommendations P-10-2 (Urgent) and P-10-3 (Urgent) to accurately determine the maximum allowable operating pressure of Pacific Gas and Electric Company natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing, determine the maximum allowable operating pressure with a spike test followed by a hydrostatic pressure test. (P-10-4)

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<sup>3</sup> Some relevant records may not currently be in PG&E's possession, such as those that may reside with the city of San Bruno, San Mateo County, the state of California, or former employees or contractors of PG&E. During the investigation of the collapse of the I-35W Highway Bridge in Minneapolis, Minnesota, on August 1, 2007, NTSB investigators interviewed retired engineers and other technical personnel who had worked on the design of the bridge in the early 1960s. In the course of their interviews, NTSB investigators were provided with critical engineering records related to the bridge design that had been personally retained by one of the retired employees of the company that had designed the bridge. See *Collapse of I-35W Highway Bridge, Minneapolis, Minnesota, August 1, 2007*, Highway Accident Report NTSB/HAR-08/03 (Washington, DC: National Transportation Safety Board, 2008), pp. 78, 103, on the NTSB website at <<http://www.nts.gov/publicctn/2008/HAR0803.pdf>>.

<sup>4</sup> Class 3 refers to any location unit that has 46 or more buildings intended for human occupancy. Class 4 refers to any class location unit where buildings with four or more stories above ground are prevalent.

<sup>5</sup> Class 1 refers to an offshore area or any class location unit that has 10 or fewer buildings intended for human occupancy. A class 2 location is any class location unit that has more than 10 but fewer than 46 buildings intended for human occupancy.

<sup>6</sup> A high consequence area is any class 3 or 4 location or any area where a potential impact radius of 660 feet would contain more than 20 buildings intended for human occupancy.

The NTSB also issued a safety recommendation to the Pipeline and Hazardous Materials Safety Administration:

Through appropriate and expeditious means such as advisory bulletins and posting on your website, immediately inform the pipeline industry of the circumstances leading up to and the consequences of the September 9, 2010, pipeline rupture in San Bruno, California, and the National Transportation Safety Board's urgent safety recommendations to Pacific Gas and Electric Company so that pipeline operators can proactively implement corrective measures as appropriate for their pipeline systems. (P-10-1) (Urgent)

The NTSB also issued safety recommendations to the California Public Utilities Commission:

Develop an implementation schedule for the requirements of Safety Recommendation P-10-2 (Urgent) to Pacific Gas and Electric Company (PG&E) and ensure, through adequate oversight, that PG&E has aggressively and diligently searched documents and records relating to pipeline system components, such as pipe segments, valves, fittings, and weld seams, for PG&E natural gas transmission lines in class 3 and class 4 locations and class 1 and class 2 high consequence areas that have not had a maximum allowable operating pressure established through prior hydrostatic testing as outlined in Safety Recommendation P-10-2 (Urgent) to PG&E. These records should be traceable, verifiable, and complete; should meet your regulatory intent and requirements; and should have been considered in determining maximum allowable operating pressures for PG&E pipelines. (P-10-5) (Urgent).

If such a document and records search cannot be satisfactorily completed, provide oversight to any spike and hydrostatic tests that Pacific Gas and Electric Company is required to perform according to Safety Recommendation P-10-4. (P-10-6) (Urgent)

Through appropriate and expeditious means, including posting on your website, immediately inform California intrastate natural gas transmission operators of the circumstances leading up to and the consequences of the September 9, 2010, pipeline rupture in San Bruno, California, and the National Transportation Safety Board's urgent safety recommendations to Pacific Gas and Electric Company so that pipeline operators can proactively implement corrective measures as appropriate for their pipeline systems. (P-10-7) (Urgent)

In response to the recommendations in this letter, please refer to Safety Recommendations P-10-2 and -3 (Urgent) and P-10-4. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: [correspondence@ntsb.gov](mailto:correspondence@ntsb.gov). If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

*[Original Signed]*

By: Deborah A.P. Hersman  
Chairman